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THESIS

AN OPERATIONAL STATISTICAL ANALYSIS OF UNITED STATES MARINE CORPS CIVILIAN EMPLOYEE INJURY TRACKING PROCESS AND INJURY DATA

by

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June 2008

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Organizations within the Department of Defense (DoD) and Department of Labor (DoL) report safety metrics that quantify DoD civilian employee injury incident rates and lost work time for all military services. Based on these metrics, the United States Marine Corps (USMC) is experiencing high injury rates and lost work time in relation to adjacent services. This thesis recommends process improvements for tracking injuries and handling data, as well as a time series prediction methodology for investigating the causes of injuries (e.g., slips trips and falls, manual handling of equipment) and the types of injuries (e.g., back conditions, burns, bruises) that may assist the USMC in focusing its safety plans and efforts and reducing civilian employee injury rates.

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AN OPERATIONAL STATISTICAL ANALYSIS OF UNITED STATES MARINE CORPS CIVILIAN EMPLOYEE INJURY TRACKING PROCESS AND INJURY DATA

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ABSTRACT

Organizations within the Department of Defense (DoD) and Department of Labor (DoL) report safety metrics that quantify DoD civilian employee injury incident rates and lost work time for all military services. Based on these metrics, the United States Marine Corps (USMC) is experiencing high injury rates and lost work time in relation to other services. This thesis recommends process improvements for tracking injuries and handling data, as well as a time series prediction methodology for investigating the causes of injuries (e.g., slips trips and falls, manual handling of equipment), and the types of injuries (e.g., back conditions, burns, bruises) that may assist the USMC in focusing its safety plans and efforts and reducing civilian employee injury rates.

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LIST OF ACRONYMS AND ABBREVIATIONS

AFSAS	Air Force Safety Automated System
BLS	Bureau of Labor and Statistics
CB	Crystal Ball
CNA	Center for Naval Analysis
COP	Continuation of Pay
CPMS	Civilian Personnel Management Center
CS	Compensation Specialist
CSV	Comma Separated Values
DART	Days Away from Work Restricted or Transferred
DefPAC	Defense Portal Analysis Center
DMDC	Defense Manpower Data Center
DoD	Department of Defense
DoL	Department of Labor
DSES	Defense Safety Enterprise System
DSOC	Defense Safety Oversight Council
DIUCS	Defense Injury and Unemployment Compensation System
ESB	Executive Safety Board
FECA	Federal Employee Compensation Act
GUI	Graphic User Interface
HFB	Human Factors Board
HQMC	Headquarters Marine Corps
ICPA	Injury Compensation Program Administrator
JSSC	Joint Services Safety Council
LTCR	Lost Time Case Rate
LWD	Lost Work Days
LWDR	Lost Work Day Rate
LWOP	Leave without Pay
MOE	Measure of Effectiveness
MCLB	Marine Corps Logistics Base

NAICS	North American Industry Classification System
NAS	Naval Audit Service
NESB	Navy Executive Safety Board
NPS	Naval Postgraduate School
NSC	Naval Safety Center
OIG	Office of Inspector General
OPM	Office of Personnel Management
OSHA	Occupational Safety and Health Administration
OWCP	Office of Workers' Compensation Program
RMSE	Root Mean Square Error
SD	Safety Division
SDE	Standard Data Elements
SHARE	Safety Health and Return to Employment
SIC	Standard Industrial Classification
SM	Safety Manager
TCR	Total Case Rate
TCIR	Total Case Incident Rate
UIC	Unit Identification Code
USA	United States Army
USMC	United States Marine Corps
USN	United States Navy
VPP	Voluntary Protection Program
WESS	Web Enabled Safety System

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EXECUTIVE SUMMARY

In 2001, Secretary of Defense Donald Rumsfeld issued a Mishap Reduction Initiative to reduce injuries and illnesses within the Department of Defense (DoD). As part of the Mishap Reduction Initiative, a DoD challenge was issued to all services to achieve a 50% (and later 75%) across-the-board mishap reduction by the end of FY 2008 (NSC, 2008).

The United States Marine Corps (USMC) has the highest appropriated civilian employee injury total case rate and lost workdays within the DoD, as reported by the Occupational Safety and Health Administration (OSHA) and Defense Manpower Data Center.

This study analyzes injuries and recommends thresholds and goals related to USMC injury hazards. The research evaluates existing safety metrics, the USMC injury tracking process and DoD injury data.

Time series analysis is used to demonstrate the much higher standard deviation (or spread) in USMC Total Case Rate (TCR) for the top three causes of injury. The standard deviation for TCR in the USMC data is 300% that of other services. The much smaller population of USMC civilian employees underlies this disparity.

As described more fully in Chapter IV, this research has resulted in the following recommendations to improve the Marine Corps injury tracking process and to reduce Marine Corps injury rates.

1. Select and use one common database that spans DoD and Department of Labor. In particular, the "Defense Portal Analysis Center" (DefPAC) can serve as the common data source for both safety and human resources for tracking injury claims and data.
2. Establish a forum within the injury tracking process to communicate and crosscheck injury data. In particular, establish a "Federal Employee Compensation Act (FECA) Council" at each installation to ensure Safety Managers and Injury Compensation Program Administrators are consistently tracking and updating injuries.

3. Use time series methods to measure and project future performance. Promote safety audit programs such as OSHA's Voluntary Protection Program to aid in refining safety programs.
4. Improve the recordkeeping process so that more detailed data is available to analyze injury trends and causes. In particular, define the OSHA site code on the CA-1 form to map to an installation's safety department and add this field to DefPAC.

I. INTRODUCTION

The Safety, Health, and Return to Employment (SHARE) initiative was launched in 2004, by President George W. Bush, with the purpose of reducing occupational injuries, illnesses and fatalities within the Federal government. The Department of Labor (DoL) was designated the lead department within the federal government to track progress. Using fiscal year (FY) 2003 as a baseline, SHARE encouraged U.S. government departments and agencies to work in a collaborative environment to achieve these goals:

1) Reduce total case rates for injuries and illnesses by at least 3% per year.
2) Reduce case rates for lost time injuries and illnesses by at least 3% per year.
3) Increase the timely filing of injury and illness notices by at least 5% per year.
4) Reduce the rates of lost production days due to injuries and illnesses by at least 1% per year.

The SHARE initiative was recently extended through FY 2009, underscoring the federal government's continuing commitment to lowering civilian employee injury/illness safety cases (Chao, 2006).

In 2001, prior to SHARE, Secretary of Defense Donald Rumsfeld issued a Mishap Reduction Initiative to reduce injuries and illnesses within the Department of Defense (DoD). As part of the Mishap Reduction Initiative, a DoD challenge was issued to all services to achieve a 50%, across-the-board, mishap reduction by the end of FY 2005 (Nelson, 2005). In their FY 2007 guidance, the Secretary of the Navy, the Chief of Naval Operations and the Commandant of the Marine Corps extended and reinforced the mishap reduction plan with a goal to reduce baseline mishap rates injuries by 75% (NSC, 2007).

A. MEASURING AND TRACKING SAFETY

Three different organizations provide safety metrics and five entities manage data associated with measuring safety for the military services' civilian employees. Metric

descriptions are listed in Table 1. Table 2 lists the additional organizations responsible for data handling. The formulas for calculating the various safety metrics are listed in detail in Appendix A.

	Department	Metric	Acronym	Description
1	Occupational Safety and Health Administration (OSHA)	Total Case Incident Rate	TCIR	Sum of recordable non-fatal injuries plus illnesses divided by total number of non-appropriated and appropriated employee hours worked (in a given period). The resulting number is multiplied by a scaling factor of 200,000 (equivalent of 100 full-time workers working 40-hours per week, 50 weeks per year).
		Days Away from Work Restricted or Transferred	DART	Sum of recordable non-fatal injuries plus illnesses resulting in days away from work divided by total number of non-appropriated and appropriated employee hours worked (in a given period). The resulting number is multiplied by the same scaling factor of 200,000
2	Defense Manpower Data Center (DMDC)	Lost Work Days	LWD	Calculated from civilian employee payroll data. Sum of total LWD from Continuation of Pay (COP) and Leave without Pay (LWOP) hours logged in payroll files. No descriptive injury data.
		Lost Work Day Rate	LWDR	Calculated from civilian employee payroll data. Sum of total LWD from COP and LWOP hours logged in payroll files divided by total hours worked for a given time period. The resulting number is multiplied by a scaling factor of 200,000. No descriptive injury data
3	Office of Workers' Compensation Program (OWCP) SHARE Initiative	Total Case Rate	TCR	Number of total injury cases divided by the number of employees. The resulting number is then multiplied by 100, for a rate per 100 employees.
		Lost Time Case Rate	LTCR	Total time associated with lost cases divided by the number of employees. The resulting number is then multiplied by 100, for a rate per 100 employees.

Table 1. Description of Military Service Civilian Employee Injury and Illness Safety Metrics

	Office	Data	Data Management Description
4	Office of Personnel Management (OPM)	Civilian Employee Numbers	Provides the number of civilian employees per service for calculating SHARE initiative metrics.
5	Civilian Personnel Management Center (CPMS)	Appropriated Civilian Employee Injury Claims Submitted	Provides the number of illnesses and injuries of appropriated civilian employees per service. Used to calculate SHARE initiative metrics. Managed through the Defense Portal Analysis Center (DefPAC).

Table 2. Other Organizations Providing Data

Existing organizations analyze the various safety metrics to lower civilian employee injury rates. For example:

- The Vice Chief of Naval Operations' Navy Executive Safety Board (NESB) and the Assistant Commandant of the Marine Corps' Executive Safety Board (ESB) periodically monitor fluctuations in the metrics listed in Table 1.
- OWCP tracks TCR and LTCR (SHARE metrics), as well as their rates of decrease, since the implementation of both the DoD Mishap Reduction and SHARE initiatives.

Of particular concern to the United States Marine Corps (USMC) ESB is that the USMC has the highest TCR among the services as reported by DoL Federal Injury and Illness Statistics for Fiscal Year 2007 (DoL, 2007). The Marine Corps also has the highest civilian employee LWDR within DoD.

Furthermore, high injury rates cost the services money. Specifically, DoD installations are assessed chargeback fees, in millions of dollars, for civilian employee lost work time and for the annual OWCP medical care claims. In 2007, the total DoD chargeback fees (all services and agencies) accrued was in excess of $553 million (CPMS, 2008). Figure 1 shows the total DoD chargeback fees for calendar years (CYs) 2005-2007. Note that chargeback fees include medical bills; therefore, this economic indicator is not solely a function of how safely installations are operating.

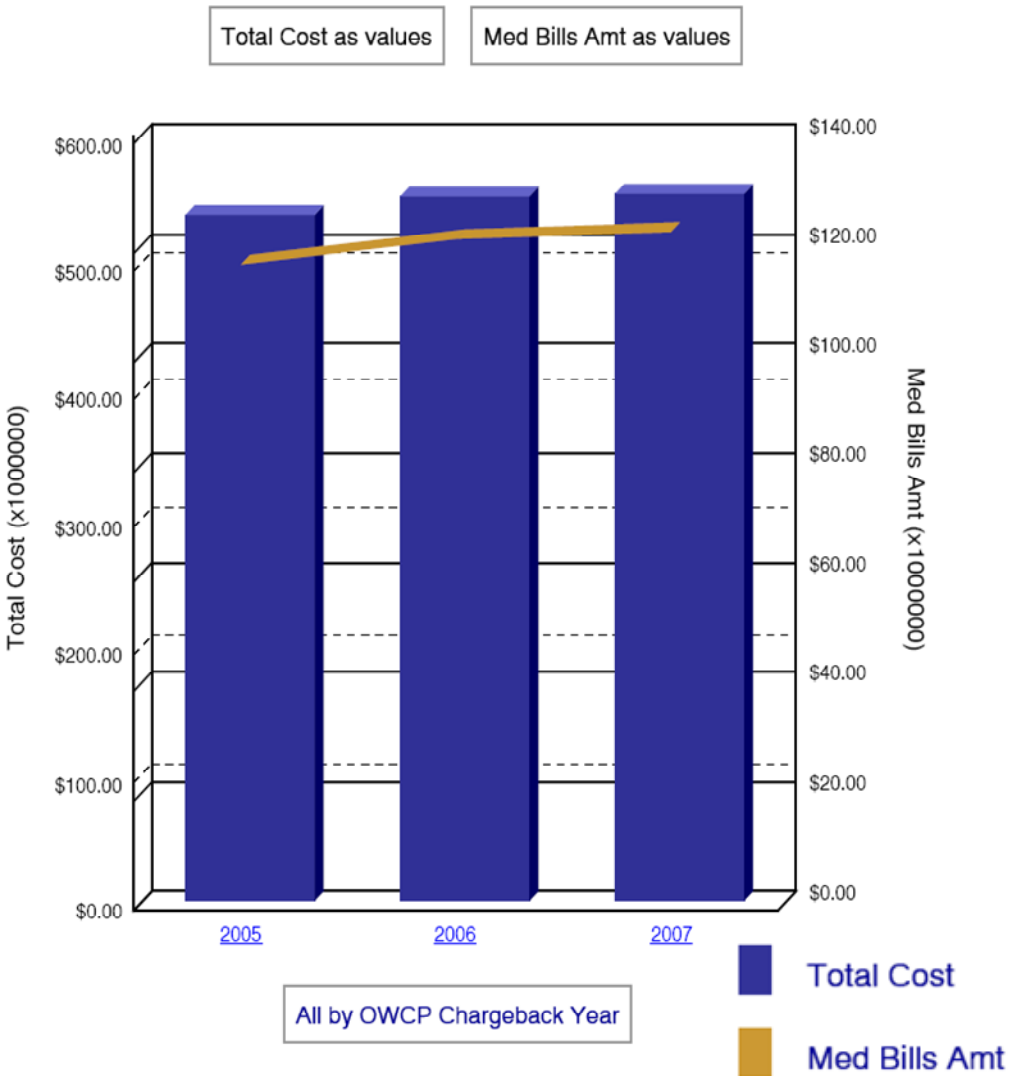


Figure 1. Total DoD Chargeback Fees for CYs 2005-2007 From (CPMS, 2007)

In spite of undoubtedly well-intentioned efforts, it appears that the current injury tracking/measurement system has evolved in such a fashion that it simultaneously has too many metrics while not providing sufficient (actionable) information.

1. Too Many Metrics

Multiple metrics tracked by different organizations have the potential to result in confusion when discrepancies exist. In addition, multiple metrics may complicate decision making. For example, safety departments concerned with reducing injuries must sift through the various metrics for information to determine how to minimize injuries and preserve their civilian workforce.

Additionally, safety metrics presented in different forms make interpretation difficult and provide little added value. For example, Figures 2 and 3 were used to summarize LWD to decision makers in February and April 2008, respectively. (Specific formulas used to calculate the LWD and the LWDR confidence interval are listed in Appendix A).

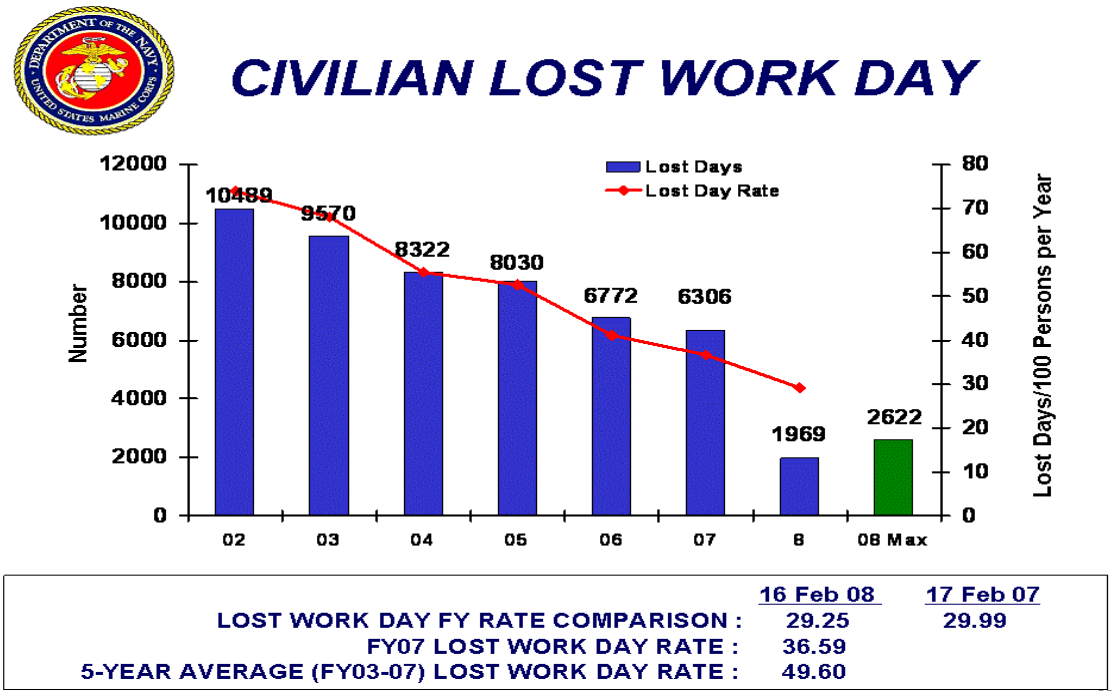


Figure 2. USMC Civilian LWD Chart From (NSC, 2008)

Figure 2 is a graph of Marine Corps civilian LWD and the LWDR (100 persons per year). The bars are the total number of LWDs and the line is the civilian LWDR. The NSC also reports TCIRs and DART. Figure 3 provides a scoreboard representation compared to the USMC goal (50 or 75 percent reduction). Marine Corps executives may deduce from Figure 2 that the USMC is below the historical trend and below the 2008 goal. However, based on this data, they gain no insight into what injuries are causing LWD or LWDR to fluctuate.

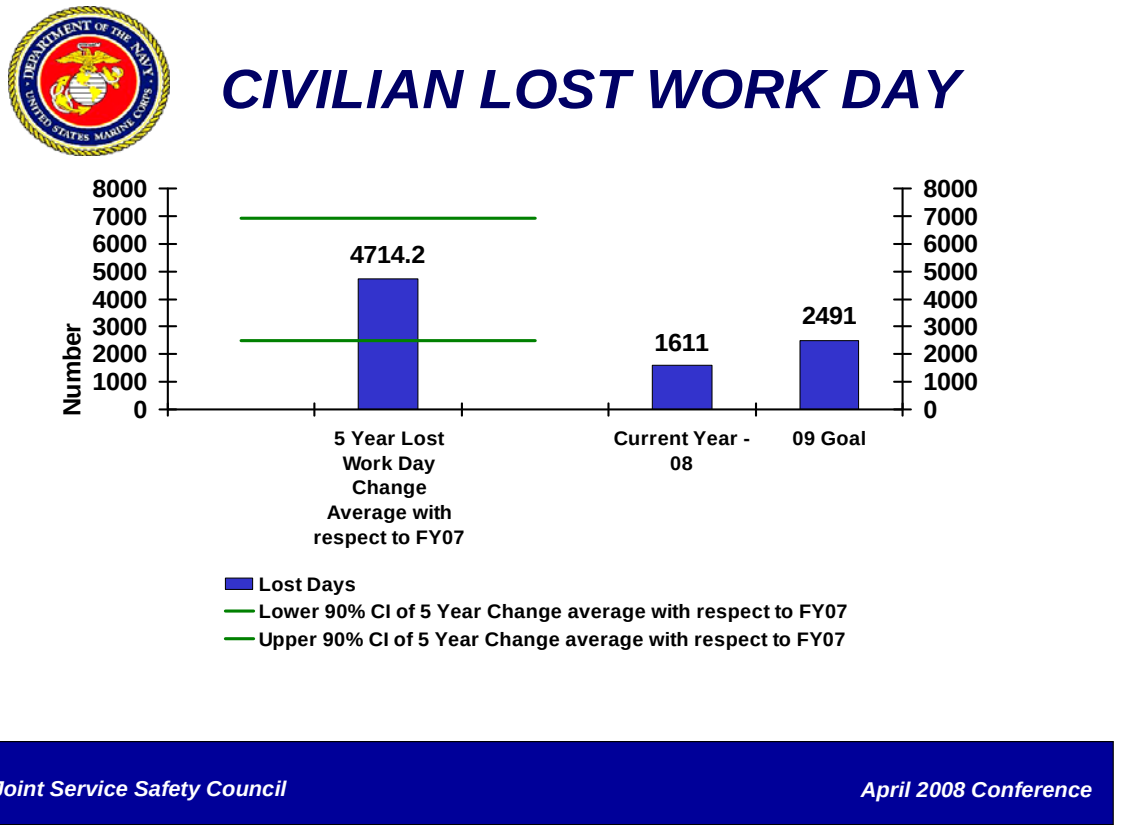


Figure 3. JSSC Conference Brief (NSC, 2008)

Figure 3 establishes ceilings or thresholds (represented by upper and lower levels) for the USMC to gauge LWDs. The confidence interval (a measure of how likely an interval will contain the yearly average LWD) uses the assumption LWDs are from a Poisson distribution. The Poisson distribution is used to represent events that happen

rarely and at a certain rate of occurrence. Similar to Figure 2, executives deduce the USMC is below the historical trend and below the 2009 goal. The confidence interval provides an indication that the decrease in 2008 is statistically significantly different from previous years.

While the information in the previous charts is useful and essential when formulating a safety game plan, additional information is needed on injuries.

2. Not Enough Information

The existing metrics do not provide information about what actions to take to lower LWDRs and LTCRs – an area of great interest to leaders within the Marine Corps. Similarly, Headquarters Marine Corps Safety Division (HQMC SD) is specifically interested in which hazards have the highest injury rates and in the effectiveness of existing programs, such as OSHA's Voluntary Protection Program (VPP), yet the metrics provide little insight. HQMC SD also needs information to answer questions such as:

- What is causing injuries?
- What types of injuries are occurring most frequently?
- How can the USMC measure an installation's injury tracking effectiveness?
- What injury tracking process improvements will provide the most accurate safety metrics?

An overemphasis on LWD and LWDR metrics may be due to guidance initially set forth by DoD. In 2006, Secretary of Defense Donald Rumsfeld stressed the need to reference the database which affects economic variables the most. Secretary of Defense Rumsfeld stated, "Find out how Treasury manages Lost Days and do it using the same calculations" (Angello, 2006). LWD and LWDR are economic metrics associated with the treasury; however, there is no specific injury information associated with payroll data.

Multiple studies by various organizations – including the Naval Audit Service (NAS), Center for Naval Analysis (CNA), Marine Corps Logistics Base Barstow, and the Naval Postgraduate School (NPS) – have evaluated the factors or events associated with the USMC's high LWDR and/or LTCR. None of these studies investigates the factors

causing the most injuries (e.g., slips trips and falls, animal bites, manual handling of equipment) or the types of injuries (e.g., back injury, bruises, and burns). None of the studies examines how the Marine Corps could improve its processes to provide actionable information to safety managers and other decision makers.

B. RESULTS FROM PREVIOUS STUDIES

A NPS study conducted by Captain Timothy Robinson, USMC in 2007 showed that LWD and LWDR are directly proportional to the size of the employee population. Captain Robinson stated:

> An increase in employees can be directly related to an increase in LWD. For example, throughout early 2003, the percent change in number of employees increased. Likewise, the percent change in LWD totals increased in this same period. From 2005 to 2006 the percent change in the number of employees decreased along with the percent change in the number of LWD. However, an increase in total LWD does not necessarily imply an increase in the LWD rate. From 2003 to 2006, the civilian workforce has risen from 14750 to 17845, a total of 17.3%. Despite this significant increase, the USMC has decreased the annual LWD rate by 10% (Robinson, 2007).

Additionally Captain Robison's thesis supported the notion that a small amount of workers account for the majority of LWDs within the USMC, and workers such as firefighters and police officers were more at risk for injury, Robinson stated:

> Analysis of the DMDC data reveals that fire-fighters, security forces, and mechanics are at the greatest risk for accruing a LWD The next high risk group is equipment operators that are of pay grade GS10 or below (Robinson, 2007).

The same study also identified data discrepancies between DMDC and NSC. In particular, it found that LWD as calculated by DMDC and NSC differ significantly. Table 4 shows the number of LWD calculated by DMDC. Table 5 shows the number of LWD calculated by the NSC.

	2000	2001	2002	2003	2004	2005	2006
USMC	3047.39	8396.08	10949.42	8651.76	7952.27	7939.82	5653.26
USN	22353.02	54309.27	69735.84	64320.76	58104.55	48018.85	41965.19

Table 3. DMDC: Total number of LWD by CY From (Robinson, 2007)

	2000	2001	2002	2003	2004	2005	2006
USMC	2224	2285	3586	1729	803	2473	1560
USN	1191	662	470	1649	13585	17312	20633

Table 4. NSC: Total number of LWD by CY From (Robinson, 2007)

Figure 4 further illustrates that differences extend down to the installation level.

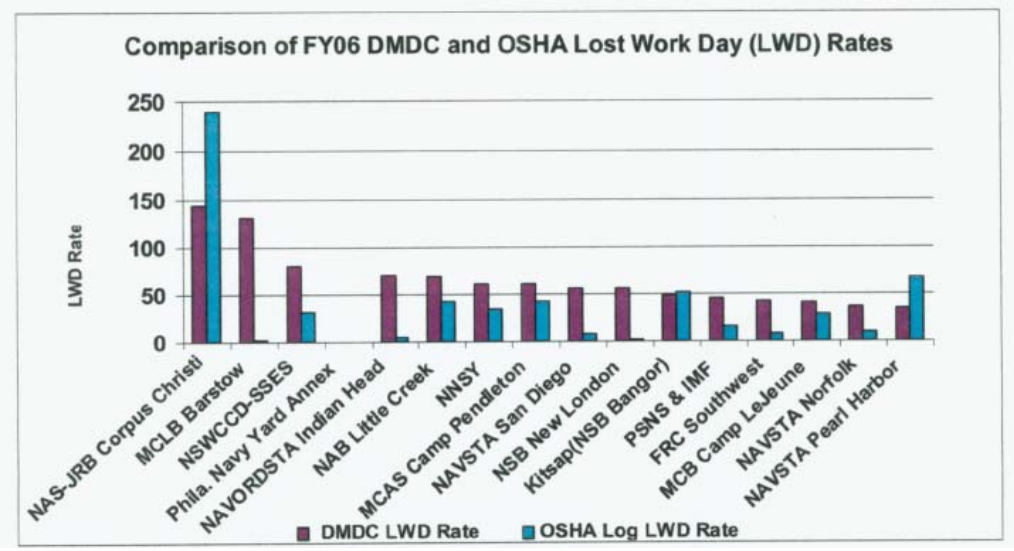


Figure 4. Lost Work Day Rates-OSHA 300 and DMDC From (NSC, 2006)

In 2004, to investigate slow progress on goals established by the Secretary of Navy, NAS conducted a study: Reducing Lost Work Time due to On-the-Job Injuries at Navy and Marine Corps Commands. In the study, a requirement for human resource and safety departments to collaborate through Federal Employee Compensation Act (FECA) working groups was noted:

> The initial finding was a lack of specific mandated requirements in current USN and USMC directives. NAS also found an "overall lack of consistent partnerships between the ICPAs, supervisors, and safety and occupational health departments, and an overall lack of implementation of best practices and controls to reduce lost time due to injuries." (NAS, 2004)
>
> NAS found that some commands did not have active FECA Working Groups that analyzed historical data, established goals and identify strategies to achieve these goals with the abilities to hold managers and supervisors accountable. NAS also found that some commands had FECA working groups, but they excluded key personnel, such as the commanding officers, department heads, human resource personnel, and shop supervisors. (NAS, 2004)

In summary, previous studies on civilian employee LWD/LWDR have concluded that:

- LWD and LWDR vary with the size of an employee population.
- Lost Work Time data and OSHA Log data differ between the NSC and DMDC.
- Studies focused on LWDs and LWDR analysis and not hazards or injury types.

C. ORGANIZATION OF THE THESIS

This first chapter motivated the study of USMC safety metrics and provided the basic definitions of the various safety metrics. The second chapter focuses on the existing injury submission process and additional background information to ensure an understanding of the injury process. Analyses follow in the third chapter, with information about the data, data analysis, and analysis interpretation. Lastly, recommendations resulting from the study are in the fourth chapter.

II. BACKGROUND AND INJURY TRACKING PROCESS

This chapter provides an overview of worker's compensation, a description of the injury tracking process, and an overview of the various organizations associated with the injury tracking process. It provides the necessary background information to put the subsequent analysis and recommendations in the proper context.

A. DEFINING WORKERS' COMPENSATION

The FECA governs claims filed by federally appropriated employees. If a DoD civilian employee is injured at work, OWCP provides compensation for wage replacement benefits, medical treatment and vocational rehabilitation. In sum, these benefits are commonly referred to as workers' compensation. The Longshore and Harbor Workers' Compensation Program governs non-appropriated employee workers' compensation claims.

B. ORGANIZATIONS INVOLVED WITH SAFETY METRICS

Multiple organizations in the DoD and DoL are involved with USMC safety metrics. Relevant DoL organizations and programs are first described below, followed by DoD organizations and systems, and then other federal agencies.

1. Department of Labor

a. Office of Workers' Compensation Program

OWCP manages the workers' compensation claims process and is responsible for updates as claims are validated or denied. OWCP does not track payroll data; they report a safety metric via the SHARE initiative formula described in Appendix A. The SHARE metric uses a claim total delineated by "claim-create date" or "lost time claim-create."

b. Occupational Safety Health and Administration

OSHA sets the safety and health standards for civilian employees across the nation. DoD is subject to standards set forth by OSHA.

OSHA works with a corporation's or service installation's leadership and develops standards, injury record keeping guidance, and educational programs to increase workplace safety. Safety entities use record keeping guidance described in the OSHA Record Keeping Handbook and within OSHA logs and forms designated for tracking injuries. The safety metrics provided by OSHA are TCIR and DART (see Appendix A).

OSHA tracks both appropriated and non-appropriated employee injuries combined together, unlike OWCP who only tracks appropriated. Instead of using number of employees in the denominator, OSHA TCIR and DART metrics use number of hours worked. Calculating the metric requires input from human resources.

c. Voluntary Protection Program

An OSHA sponsored program, VPP promotes effective worksite-based safety and health. During the VPP application process, management, labor, and OSHA establish cooperative relationships at workplaces. Approval of a VPP application is OSHA's official recognition of organizations that achieve exemplary occupational safety and health (OSHA DoL, 2008). VPP ratings (Star, Merit or Demonstration) are assigned to USMC installations based on a comparison to civilian companies. Below is OSHA's description of VPP:

1) The entire installation, to include leadership, management, hazard prevention and control, and Safety and Health Training, work together to achieve and fine-tune their existing safety plan.
2) The site submits an application, which describes the current safety plan, to OSHA.
3) OSHA evaluates the application and conducts an on-site visit or audit.
4) TCIR and DART rates are compared to industry averages as a quantitative assessment of site safety.
5) Installations qualifying for VPP attain Star, Merit, or Demonstration status:

- Star participants meet all VPP requirements.
- Merit participants have demonstrated the potential and willingness to achieve Star status, but some aspects of their programs need improvement.
- Demonstration participants test alternative ways to achieve safety and health excellence.

6) OSHA makes the following comment concerning VPP, within the application:

> Statistical evidence for VPP's success is impressive. Consistently since the Programs began, the average VPP worksite has had a recordable incidence rate for days away from work, restricted work activity, and/or job transfer (DART rate) about 50 percent below the average for its industry (OSHA, 2007)!

Seven Marine Corps installations have applied to the VPP program. MCLB Barstow attained a star rating from OSHA on April 21, 2008 (Coyle, 2008). MCLB Barstow's application is discussed in the analysis chapter of this thesis.

d. Office of Inspector General

The DoL Office of Inspector General (OIG) is responsible for investigating fraudulent OWCP cases. The Semi-Annual Report, Oct 2005-Mar 2006 for the DoL OIG summarizes the impact of fraudulent cases on the US government:

> Since 1993, government costs for FECA benefits have increased more than 30% to 2.4 billion in 2005. This has prompted Federal agencies and their OIGs to find ways to reduce costs, return people to work, and identify and prevent fraud in the program. On March 22, 2006, the DoL OIG, along with the Department of Commerce OIG, hosted a symposium for the entire OIG community to address issues relating to the FECA program. The goal of the symposium was to engage the inspector general community in a more coordinated and collaborative approach to doing work related to the FECA program. The symposium was supported by management, who gave a presentation and offered continuing assistance to OIGs throughout government to address FECA issues in their respective agencies. Some 150 OIG auditors, inspectors, evaluators, and investigators from across the government attended. As part of this symposium, the OIG community is developing a comprehensive long-term plan to address this complex issue (Heddell, 2006).

2. Department of Defense

a. Naval Safety Center

The NSC is responsible for both the Navy and Marine Corps' safety programs and injury data. Injuries are reported to the NSC via installation OSHA data logs. Log data are uploaded to the NSC's database via the Web Enabled Safety System (WESS). The NSC uses TCIR and DART safety metrics, which coincides with OSHA and VPP safety metrics. Recently the NSC has also been reporting LWD and LWDR. This is evident on the Navy and Marine Corps Executive Safety Summary website (NSC, 2008).

b. Headquarter Marine Corps Safety Division

HQMC SD collaborates with the NSC and reports to the Assistant Commandant of the Marine Corps on all safety items. Safety metrics for civilian employees tracked at HQMC SD are LWDR and number of new injury cases. Installations are responsible for reporting to HQMC SD on various Warrior Preservation safety metrics throughout the year. These include the Command Climate Survey, Safe Driving Council, Supervisor Safety Committee, and safety mishaps.

c. Civilian Personnel Management System

CPMS is a DoD information management organization that provides systems management for human resources within DoD. CPMS focuses on delivering comprehensive injury tracking data to human resource via two databases: 1.) Defense Injury and Unemployment Compensation System (DIUCS) and 2.) Defense Portal Analysis Center (DefPAC). Databases are discussed further in the data handling section.

d. Office of Inspector General

OIGs across the board have been collaborating to increase awareness on potential fraudulent claims. The Commandant of the Marine Corps is briefed by the USMC OIG on "Special Interests" and one of the items briefed is that the Marine Corps has the highest injury rate of civilian employees.

Fraudulent claims directly affect the chargeback fee amount assessed to Marine Corps installations. Additionally, because the Marine Corps possesses a much smaller civilian population as compared to other services, a change in the number of injury claims has a larger effect on safety metric values.

3. Other Federal Agencies

a. Office of Personnel Management

OPM manages civilian employees and is a principal agency in the Executive Office. OPM's mission is "to build a high quality and diverse Federal workforce" (OPM, 2008). OPM contributes to the SHARE safety metrics by providing civilian employee numbers for calculating the SHARE initiative metric (the denominator in the TCR and LTCR metrics).

C. DATA HANDLING

As with safety metrics, multiple organizations in the DoD and DoL handle and manage safety data. Relevant DoL organizations are first described below, followed by DoD organizations and systems.

1. Department of Labor Data Handling

a. Office of Workers' Compensation Program

To calculate SHARE metrics, OWCP uses civilian employee data from the OPM Fed Scope Website. Injury claim data is gathered from OWCP "case-create injury" data.

DoL displays annual SHARE metrics on the OWCP website under the SHARE Initiative link. OSHA's website displays SHARE data as well. Figure 5 shows the USMC high TCR (4.34) and LCTR (3.1), per 100 employees.

Department or Agency	Employees1	Total Cases3	Total Case Rate (TCR)4	Lost Time (LT) Cases3	LT Case Rate (LTCR)4	Fatalities
Department of Defense	**673,385**	**19,688**	**2.92**	**10,325**	**1.53**	**14**
Department of Air Force	**158,726**	**4,417**	**2.78**	**2,327**	**1.47**	**5**
Department of the Army (Incl. Corps of Eng)	**221,653**	**8,154**	**3.68**	**3,896**	**1.76**	**3**
Corps of Engineers	21,989	765	3.48	315	1.43	1
Department of Navy (Incl. Marine Corps)	**175,406**	**5,132**	**2.93**	**2,800**	**1.6**	**6**
Marine Corps	15,906	690	4.34	493	3.1	1
Navy (without the Marine Corps)	159,500	4,442	2.78	2,307	1.45	5
Defense Commissary Agency	16,353	515	3.15	311	1.9	0
Defense Contract Audit Agency	3,985	27	0.68	16	0.4	0
Defense Finance and Accounting Servic	12,690	183	1.44	146	1.15	0
Defense Logistics Agency (Incl. DCMA)	20,972	645	3.08	424	2.02	0
Defense Contract Management Agency (DCMA)	9,794	78	0.8	48	0.49	0
DOD Other	63,600	615	0.97	405	0.64	0

Figure 5. SHARE Initiative Safety Metrics From (OSHA, 2007)

b. Occupational Safety Health and Administration

In addition to displaying TCR and LTCR metrics, OSHA collaborates with DoL and the Bureau of Labor Statistics (BLS) to assemble aggregate injury data. OSHA and BLS display the data using TCIR and DART metrics. These metrics focus on comparing civilian industries across the nation via Standard Industrial Classification (SIC) codes and, if applicable, the North American Industry Classification System (NAICS). This is important to the USMC when interpreting VPP application TCIR and DART metrics since TCIR and DART metrics are not compared to other military services or installations.

2. Department of Defense Data Handling

Three entities manage injury data for services within DoD. They are CPMS, DMDC and the NSC.

a. Civilian Personnel Management System

There are two CPMS databases, one for human resource management and one for safety management. Defense Injury and Unemployment Compensation System (DIUCS) is protected by the privacy act and is for human resource employees only. DIUCS allows human resource employees the ability to match an employee's pay information with a specific case or injury claim (CPMS, 2008).

Unlike DIUCS, the Defense Portal Analysis Center (DefPAC) system is accessible to safety entities and CPMS encourages safety entities to reference DefPAC. DefPAC provides information on injuries and illnesses, but no payroll data is available. It is an information base for ICPAs and has links to resources for Safety. OSHA items are also available. It is used by managers, safety, and OSHA professionals to aggregate data such as injury claims and costs, nature of injury, and cause of injury, specific to their area of responsibility.

b. Defense Manpower Data Center

DMDC maintains raw payroll data for DoD human resource departments. Payroll data is used to calculate time lost and costs associated with civilian employees being injured or having an illness. DMDC created a Top-Forty list of those military installations that have the worst LWDR as calculated by the formula in Appendix A. Additionally, within the website, there is a variety of options to look at specific installations. Military services use DMDC LWD and LWDRs to measure how safely military services operate; however, there is no descriptive injury data associated with DMDC raw payroll data according to the DMDC Top-Forty website manager (Madley, 2008) so the data cannot be used for diagnostic purposes (i.e., to help SMs identify problem areas).

c. Naval Safety Center Web Enabled Safety System

SMs upload civilian employee injury data to WESS on a periodic basis. United States Navy (USN) and USMC civilian employee injury data use different data

management structures. The USN breaks up data into sea and shore (SS) and motor vehicle (MV) data structures. The USMC uses one data structure for storing data. The data consists of personnel tables and mishap log tables. The majority of the fields are text fields and as noted in the previous studies injury numbers vary from OWCP data significantly (Robinson, 2007).

d. Defense Safety Enterprise System

DSES is a proposed data collection and injury tracking DoD web-based system. DSES intends to consolidate injury data for DoD. The system is organized around SDEs for consistency.

Some services already have a web-based system for managing civilian mishap data. For example, at the Joint Services Safety Council (JSSC) conference in November 2007, the Air Force provided a brief on the Air Force Safety Automated System (AFSAS).

DSES is an effort to standardize a method for tracking civilian employee safety metrics; although, there is a concern of lack of funding for the system. The JSSC conference executive summary in November 2007 states the following:

> During the second day of the conference, the JSSC members conducted a phone conference with the [Defense Safety Oversight Council] DSOC Executive Secretary. The initial part of the phone conference focused on the DSES. The Service Safety Chiefs consider their programming effort to comply with DSES as an unfunded requirement and requested OSD resources in order to comply. Mr. Angello stated that he would provide the Service Safety Chiefs with the resources (JSSC, 2007).

The DMDC Top-Forty website manager indicated that DSES is the potential replacement program for the Top-Forty website (Madley, 2008).

D. TRACKING AN INJURY

Figure 6 shows a parallel structure between the human resource and safety agencies within DoL and DoD.

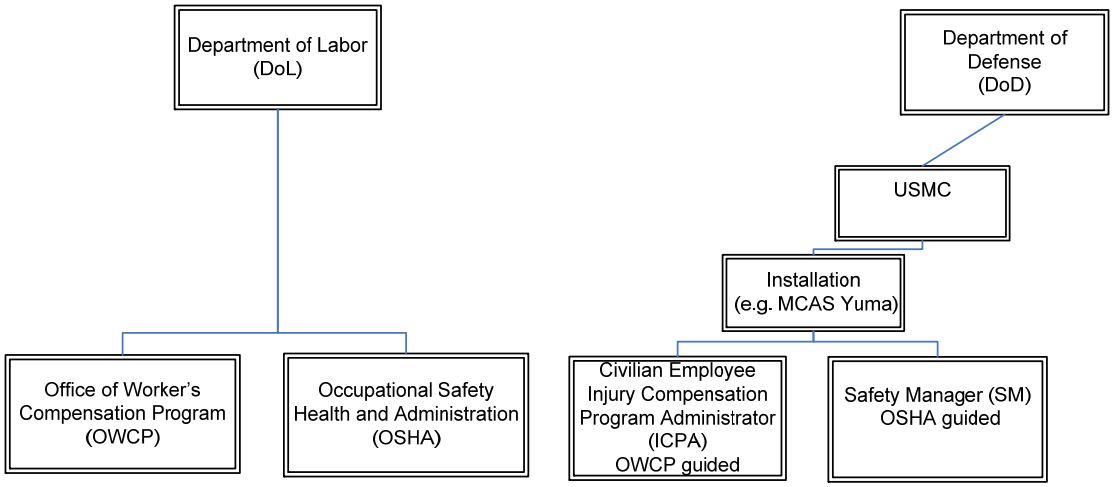


Figure 6. DoL and DoD Structure for Civilian Employee Injuries

The structure reveals consistency in the management of federal civilian employee injury cases within DoL and DoD. OWCP guides human resources and OSHA guides safety entities. This suggests the requirement for a close relationship between human resource and safety departments.

The flow chart displayed in Figure 7 describes the current injury tracking process. The safety department process is on the left side (sequenced numerically) and the human resource process is on the right side of the flow chart (sequenced alphabetically). The following format is used to describe each event:

- E-Event
- A-Action
- G-Guiding Documents

1. Current Process Flow Chart

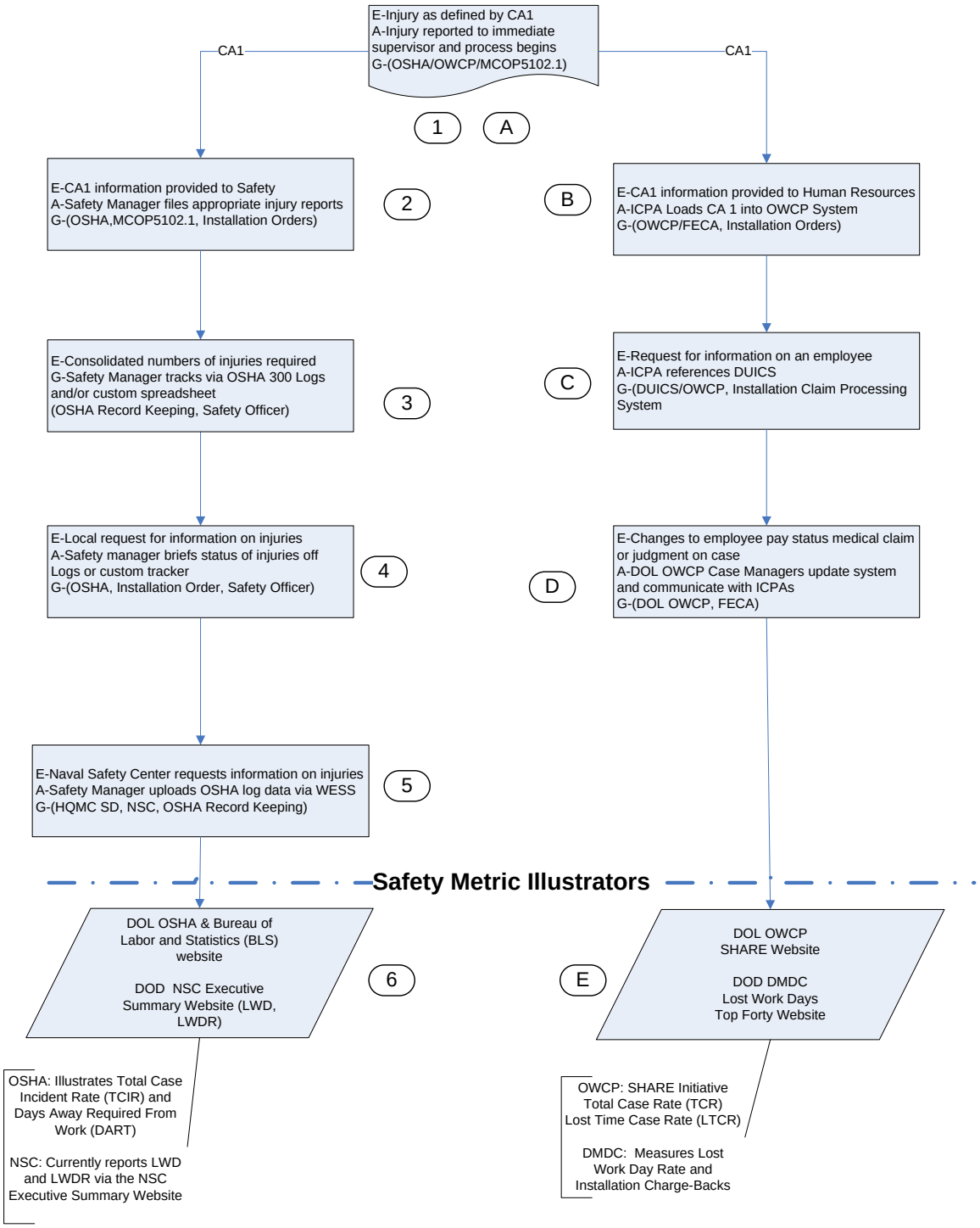


Figure 7. Current USMC Injury Tracking Process

2. Safety Process (Left Side of Flow Chart)

- 1: After a civilian employee sustains an injury a CA-1 form is filled out and the immediate supervisor is notified. The guiding document is MCOP5102.1 (Ground and Mishap Reporting) and the OSHA Record Keeping Document.
- 2: The installation safety department is responsible for documenting CA-1 form information as well as satisfying specific requirements set fort by installation orders. Additionally, an OSHA Log and Form system is maintained.
- 3: SMs keep OSHA 300 (injury) and 300A (summary of injury) logs. OSHA 301 forms are also filed as a report of incident. Documentation is guided by MCO P5102.1, the OSHA Record Keeping Document, and local orders.
- 4: Periodically SMs and officers will brief installation commanders on civilian injuries as desired by commanders.
- 5: SMs upload injury data from OSHA logs to the NSC Web Enabled Safety System.
- 6: Safety Metrics are calculated and illustrated on two websites:

  1.) DoL OSHA or BLS website (TCIR/DART)
  2.) DoD NSC Executive Summary Page website (LWD/LWDR).

3. Human Resources Process (Right Side of Flow Chart)

- A: Same as Safety Process-Step 1
- B: Once CA-1 information is received from the injured employee, the CA-1 is mailed in or faxed to DoL OWCP by the ICPA via a CPMS system. Some ICPAs may also use the Electronic Data Interchange (EDI) to upload CA-1 data to DoL. EDI is becoming the preferred method because there is a 24 to 48 hour case creation turn-around.
- C: Requests for information on an employee, once a claim is filed, is protected under the privacy act. OWCP case file mangers will work with installation ICPAs to update and resolve any discrepancies.
- D: Changes to a case file, to include pay, are made within the human resource department and are referenced via DIUCS. This information is not shared with the safety department due to the privacy act.

- E: Safety metrics are calculated and illustrated on two websites
  1.) DoL's OWCP SHARE initiative website (TCR, LTCR) and
  2.) DoD-DMDCs Top Forty Website (LWD/LWDR).

III. ANALYSIS

This chapter presents the results of an analysis on the effect of employee population size on safety metrics, describes a time series-based prediction methodology for injury hazards and types, and discusses Marine Corps Logistics Base (MCLB) Barstow's VPP application.

A. ASSUMPTIONS

The following assumptions apply to the analysis:

- Data analysis of injuries is the primary focus.
    - CA-1 forms are the source of injury information.
    - Injuries are analyzed by FY date of injury.
- Analysis of injuries and the injury tracking process is conducted based on the existing process, procedures, and methods.
    - All safety metric calculations use existing formulas
    - Injury rates per 100 employees is the preferred safety metric.
- Providing injury thresholds or confidence intervals for USMC injuries is a goal.
- Each injury has its own distribution and the majority of LWD are a byproduct of injuries. The LWD distribution does not represent a particular injury distribution.

B. DATA

1. Datasets and Dataset Management

a. OPM Employee Data

- Dates: 1999-2007
- Services: USAF, USA, USN, USMC
- Source: OPM FedScope website
- Format: Data was downloaded in Comma Separated Values (CSV)
- Analysis Software: Microsoft Excel 2003

b. DefPAC Injury and Chargeback Fee Data

- Dates: 1960-2007
- Services: DoD
- Source: Password protected database requested through CPMS
- Format: Downloadable CSV
- Analysis Software: Decisioneering, Inc. Crystal Ball (predictive modeling software; MS Excel 2003 Add-in) & JMP (statistical analysis software)
- Notes: Manipulating subcomponents within the DefPAC database requires time to become comfortable with the Graphic User Interface (GUI)

2. DoD Services Data Comparison

a. Total Employees per Service

According to OPM, approximately 571,691 civilian appropriated employees worked in DoD as of September 2007. The USMC accounts for 2% of the entire population and all military services have experienced minor fluctuations in employee numbers throughout the past nine years. Table 5 provides annual counts of DoD civilian employees by service and associated summary statistics.

Year	USAF	USA	USN	USMC
1999	162,997	234,774	192,371	14,408
2000	157,067	230,202	186,351	14,412
2001	155,028	228,783	183,260	13,751
2002	153,228	231,196	183,971	13,403
2003	152,578	231,635	185,334	13,266
2004	154,574	232,492	182,004	13,458
2005	153,647	237,581	182,315	14,495
2006	158,910	244,342	176,391	15,387
2007	158,726	221,653	175,406	15,906
Summary Statistics				
Mean	156,306	232,518	183,045	14,276
Median	155,028	231,635	183,260	14,408
Standard Deviation	3,411	6,229	5,103	915
Range	10,419	22,689	16,965	2,640
Minimum	152,578	221,653	175,406	13,266
Maximum	162,997	244,342	192,371	15,906

Table 5. Number of Appropriated Civil Service Employees

As Table 5 shows, since 1999 the USAF, USA and USN experienced slight declines in appropriated workforce sizes (roughly between 3% to 5%) while the USMC experienced a 10% increase in workforce size. Workforce size is important because the LWD and LWDR numerators and denominators are directly related to the number of employees in terms of payroll hours. The Marine Corps LWDR has changed directly with its fluctuation in civilian employee population.

b. Total CA-1s per Service

Figure 8 displays the total number of CA-1s by service by injury report date from October 1999 to December 2007 (corresponds to DoL's FY 2000-2008) total 153,620. As the next figures will show, the distribution of CA-1s across the services is much the same as the distribution of various injury causes and types across the services.

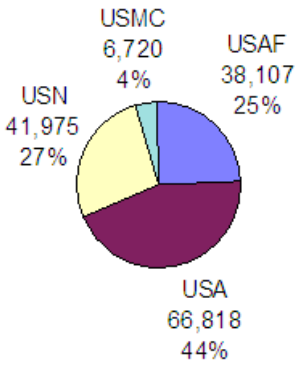


Figure 8. Total CA-1s per Service Oct 1999 to Dec 2007

c. Department of Defense "Causes of Injury"

DoD services are experiencing the same hazards (listed in Figure 9). According to DoL DefPAC data, the top three sources of injury are:

1. Manual Handling of Equipment
2. Slips or Trips and Falls
3. Unclassified

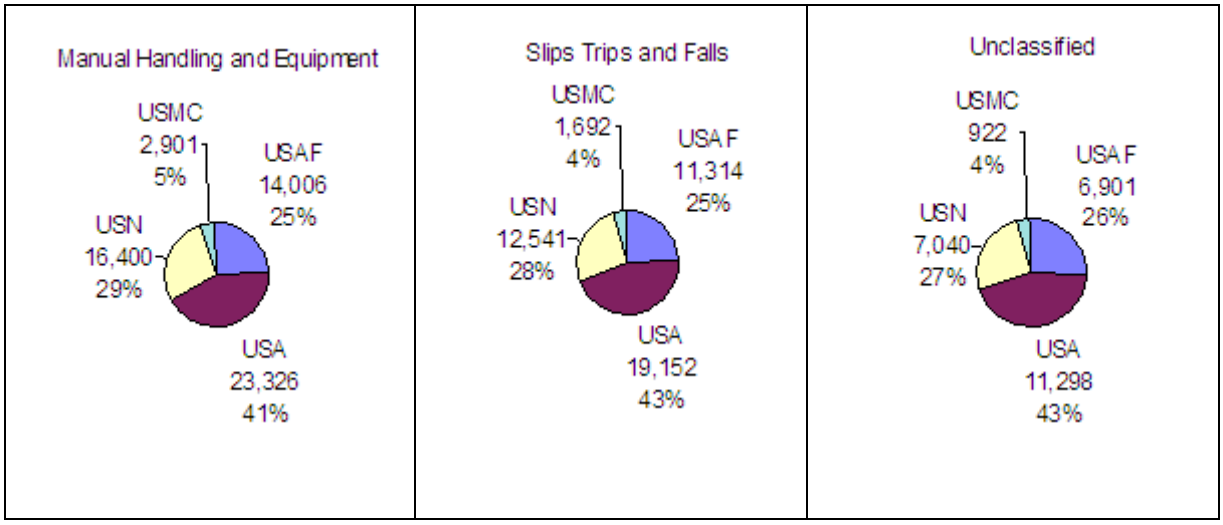


Figure 9. Percentage Distribution of Top Three Cause of Injury by Service

Together these three categories account for 83% of the injuries; Manual Handling of Equipment and Slips or Trips and Falls account for 66% of injuries within the military services.

The distribution of the top three injuries is consistent for each injury category. The Unclassified category reveals 20% of the total injuries within DoD are not specified. Services are experiencing the same top two causes of injuries and there are a significant number of injuries that are not being classified.

d. Department of Defense "Injury Type"

DoD services are also experiencing the same types of injuries (listed in Figure 10). The top three types of injury categories are:

1. Minor Contusions, Bruises or Abrasions
2. Musculoskeletal Conditions
3. Back Conditions

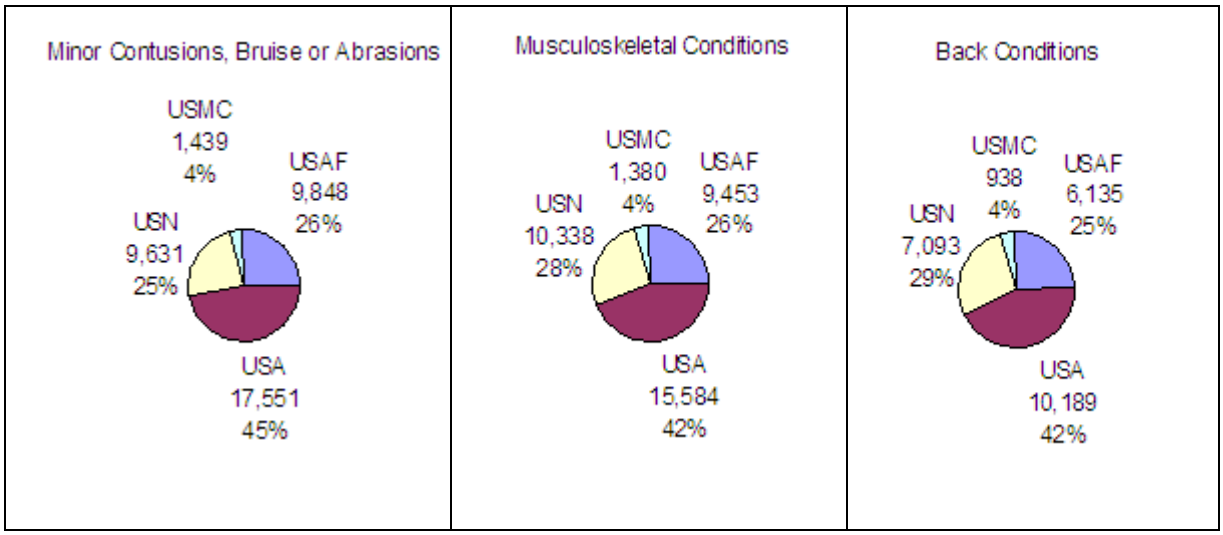


Figure 10. Percentage Distribution of Top Three Types of Injury by Service

Together these three categories account for 65% of injury types across DoD, as annotated by ICPAs and documented in DefPAC. Figure 10 shows the distribution of injuries are approximately the same for all four military services. Services are subject to the same hazards and the injuries they are sustaining are similar.

e. Effect of Population Size: More Variability in the Marine Corps

Because the Marine Corps appropriated civilian workforce is so much smaller than the other services, random fluctuations in the number of injuries are more apparent than in the other services.

For example, compare the Army's almost 222,000 appropriated employees to the Marine Corps' almost 16,000 in 2007. From Figure 11, the TCR for the Army for FY 2007 was roughly 0.3 while for the Marine Corps it was about 0.4. In 2007, the number of Army cases was about 666 while the number of Marine cases was about 64. (per the definition in Table 1, the number of cases = TCR x number of employees / 100.)

An increase of 16 cases means the Marine TCR increases a full 20 percent to 0.5 (80 x 100 / 16,000) while for the Army it only increases 2.4 percent to about 0.31 (682 x 100 / 222,000). This is evident in Figure 11, where the Marine Corps TCR fluctuates more than the other services.

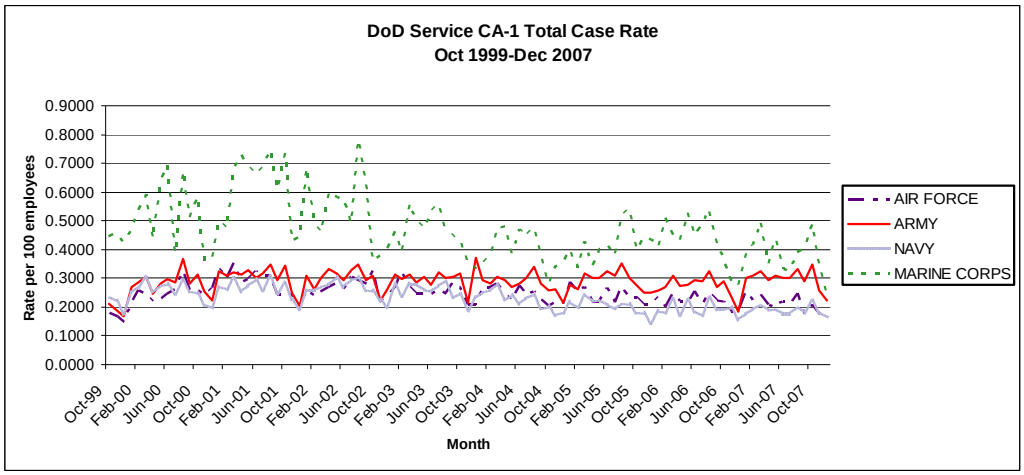


Figure 11. Total Case Rate by Service from October 1999 to December 2007

Figure 12 further highlights TCR variability from January 2007 to December 2007. To quantify the difference in variability, note that the sample variances for each of the services are USAF=0.0007, USA=0.001, USN=0.0003, and USMC=0.005.

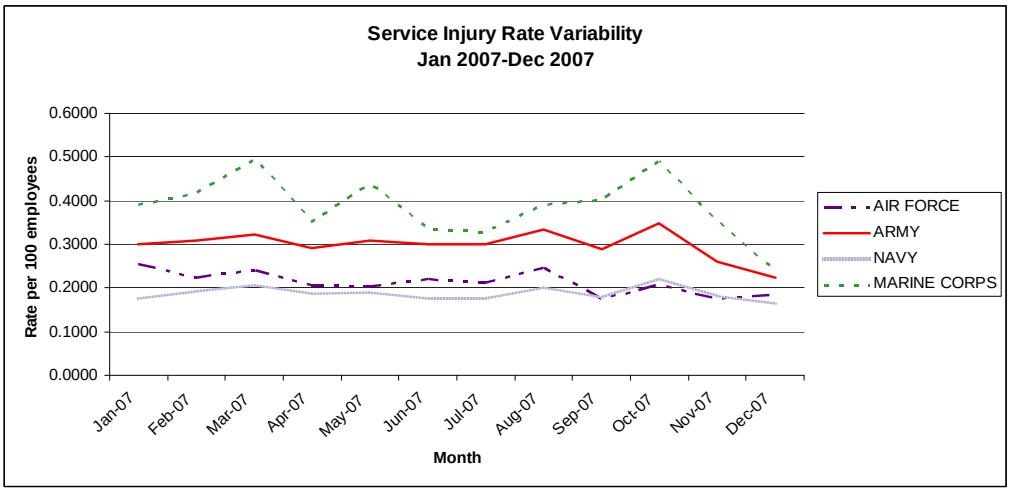


Figure 12. Total Case Rate by Service from January to December 2007

That is, the variation for the Marine Corps is almost an order of magnitude greater than the other services, which is directly related to the fact that the Marine Corps civilian workforce is roughly an order of magnitude smaller than the other services.

As the Marine Corps works to bring its average TCR in line with the other services' averages, it should expect greater fluctuation around that average from month to month. Such extra fluctuation is the natural result of a smaller employee population. What this means is that Marine Corps leaders and safety managers will need to take a longer-term view of the overall trends in the data and try to avoid chasing monthly ups and downs in the statistics, since those ups and downs may be due to nothing more than random chance.

3. Time Series Predictions with Confidence Intervals

Time series methods model how injuries occur or change over time. Various methods exist to calculate a time series and predict the outcome for future months. The author of *Spreadsheet Modeling and Decision Analysis* states the following:

> …if we can discover some sort of systematic variation in the past behavior of the series variable, we can attempt to construct a model of this behavior to help us forecast its future behavior. For example, we might find a long-term upward (or downward) trend in the time series that might be expected to continue in the future. Or, we might discover some predictable seasonal fluctuations in the data that could help us make estimates about the future (Ragsdale, 2007).

DoD injury data present in the DefPAC database is available to produce a time series prediction, which for the purposes of this analysis is defined as 12 monthly periods from January 08 to December 08. In addition to point estimates of future trends, 90% confidence intervals are also calculated to provide some indication of a range of possible future trends.

Decisioneering's Microsoft Excel add-in, Crystal Ball (CB) Predictor, was used to construct the time series models and to calculate their predictions. A nice feature of the CB Predictor is that, once data is formatted appropriately, model fitting can be automated. Time series predictions on injuries and injury thresholds are calculated with the following methodology, as defined by Ragsdale (2007) and the CB Predictor user manual.

First, a time series model is fit in which future observations are a function of past observations:

$$\hat{Y}_{t+1} = f(Y_t, Y_{t-1}, Y_{t-2}, ...).$$

In this model, the index t corresponds to the current (monthly) time period; $\hat{Y}_{t+1}$ is the predicted value for time $t+1$, Y_t represents the actual value of the variable in time *t*, Y_{t-1} is the value in period $t-1$, etcetra.

The goal is to choose a function f that will produce an accurate forecast (according to some measure) on a user-defined prediction set. There is a wide variety of functions f that are used in practice. Here we will discuss four types of time series models.

A common time series model is the Double Moving Average which applies a moving average technique twice: first on the original data and then to the resultant single moving average data. Both sets of smoothed data are used to project forward. This method is best for historical data with a trend but no seasonality. The forecast is a straight line, perhaps with a non-zero slope.

The Double Moving Average method is calculated as follows. Let M_t be the moving average for the past *k* time periods (including *t*):

$$M_t = (Y_t + Y_{t-1} + Y_{t-2} + ... + Y_{t-k+1}) / k .$$

Let the double moving average D_t for the last *k* periods (including period *t*) be the average of the moving averages:

$$D_t = (M_t + M_{t-1} + ... + M_{t-k+1}) / k .$$

Given the number of periods to forecast *n*, then the double moving average time series forecast is

$$\hat{Y}_{t+n} = E_t + nT_t ,$$

where

$$E_t = 2M_t - D_t$$

and

$$T_t = 2(M_t - D_t)/(k-1) \ .$$

In this model, E is the estimated level of the time series at time *t* and T is the estimated trend at time *t*.

The Double Moving Average is just one type of time series model. The Crystal Ball software can also fit other types of time series models. Exponential smoothing models are another useful class of time series models that can be used to model data with linear trends and various types of seasonality. Without going into the mathematical details here (see Ragsdale, 2007, for details), a description of some of these methods is listed below:

> **Holt-Winters' Additive and Multiplicative Seasonal Models**: Calculates exponentially smoothed values for level, trend, and seasonal adjustment to the forecast. The additive method is best for data with trend and with seasonality that does not increases over time. The multiplicative method is best for data with trend and seasonality that increases over time. It results in a curved forecast that reproduces the seasonal changes in the data.
>
> **Seasonal Additive Smoothing Models**: Calculates a seasonal index for historical data that do not have a trend. The method is best for data without trend but with seasonality that does not increase over time. It results in a curved forecast that reproduces the seasonal changes in the data.
>
> **Single Exponential Smoothing Models:** Recent data are weighted more heavily. Weights of past data decrease exponentially. The method is best for volatile data with no trend or seasonality. The forecast is a straight line (Decisioneering, Inc., 2004).

A number of the above models can be fit to a given set of data and then the best fitting model is chosen by some accuracy metric that quantifies how well the model fits the data. The metric used in this research is the Root Mean Square Error (RMSE):

$$RMSE = \sqrt{\frac{1}{n}\sum_{t}(Y_t - \hat{Y}_t)^2}\ ,$$

where Y_t is the actual value for time period *t*, $\hat{Y}_t$ is the forecasted value for that period, and *n* is the number of forecasted periods in the data set. RMSE measures the accuracy of the prediction – the difference between observed and forecasted values – and therefore smaller values are preferred.

a. Confidence Intervals (Injury Thresholds)

The confidence interval or injury forecast threshold defines the range within which a forecasted value has some probability of occurring. CB Predictor uses an empirical method of calculating confidence intervals. Assuming that forecast errors are normally distributed, the formula for predicting the future value of y_{t+m} at time t within a 90% confidence interval is:

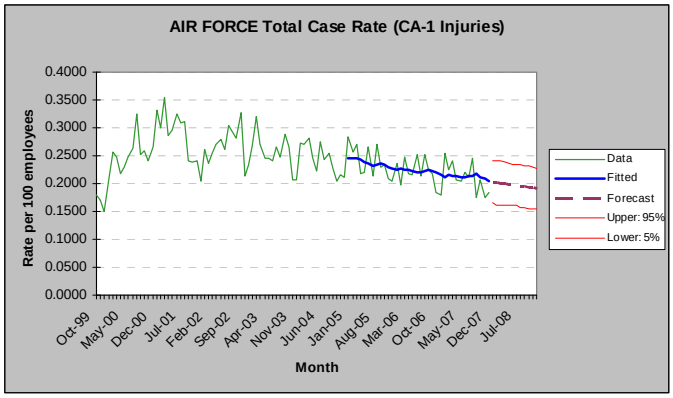
$$\hat{y}_{t+m}(t) \pm 1.6449 S(m)$$

where y_1 is the first of a set of historical data with a total of *n* observations. At time period t forecasting begins for *m* data periods (12 months) into the future. The *m*-period-ahead forecast error, at time period *t*, is denoted as $e_t(m)$. The standard error of prediciton (S) is equal to the square root of the mean of the squared forecast errors:

$$S(m) = \sqrt{\frac{\sum_{t=1}^{n-m} e_t^{\,2}(m)}{n-m}}$$

b. Time Series Predictions for Military Services

With a methodology in place, time series predictions with confidence intervals are created. Figures 13 and 14 are TCR time series prediction on military services with associated forecasts. The method with the smallest error is shown for each service.

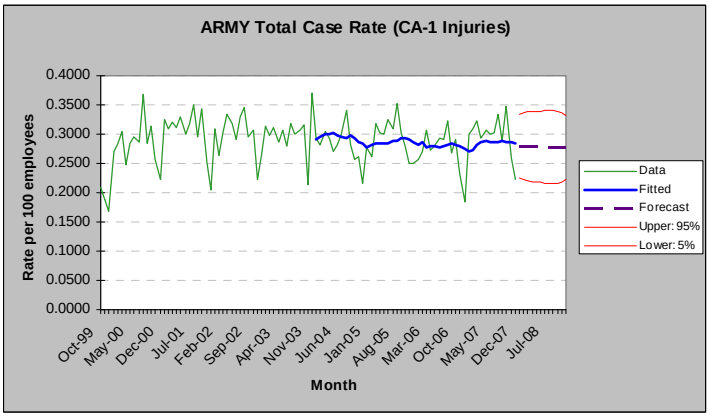


Trend: Decreasing
Forecast: 0.015 rate decrease from Jan 08 to Dec 08
Service Comparison: The USAF and USN are similar in employee population and these two services forecast the lowest rate reduction in 2008. The USAF confidence interval for Dec 2008 is also the smallest of the services.

Method: Double Moving Average
Parameters:
Periods: 32
Error: 0.02387
Series Statistics:
Mean: 0.2450
Std. Dev.: 0.0396
Minimum: 0.1503
Maximum: 0.3541

Forecast:

Date	Lower: 5%	Forecast	Upper: 95%
Jan-08	0.1648	0.2030	0.2412
Feb-08	0.1625	0.2020	0.2415
Mar-08	0.1608	0.2009	0.2411
Apr-08	0.1609	0.1999	0.2389
May-08	0.1621	0.1989	0.2356
Jun-08	0.1609	0.1978	0.2348
Jul-08	0.1602	0.1968	0.2333
Aug-08	0.1575	0.1958	0.2340
Sep-08	0.1567	0.1947	0.2327
Oct-08	0.1557	0.1937	0.2317
Nov-08	0.1551	0.1926	0.2301
Dec-08	0.1550	0.1916	0.2282



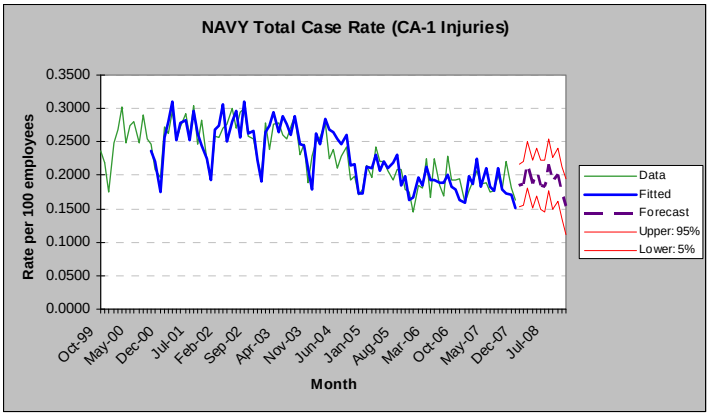
Trend: Stable to slightly decreasing
Forecast: 0.003 rate decrease from Jan 08 to Dec 08
Service Comparison: The USA has the largest employee population and the rate is relatively stable

Method: Double Moving Average
Parameters:
Periods: 26
Error: 0.03289
Series Statistics:
Mean: 0.2890
Std. Dev.: 0.0391
Minimum: 0.1674
Maximum: 0.3707

Forecast:

Date	Lower: 5%	Forecast	Upper: 95%
Jan-08	0.2251	0.2798	0.3345
Feb-08	0.2226	0.2796	0.3365
Mar-08	0.2196	0.2793	0.3391
Apr-08	0.2186	0.2791	0.3396
May-08	0.2185	0.2789	0.3392
Jun-08	0.2176	0.2786	0.3397
Jul-08	0.2163	0.2784	0.3404
Aug-08	0.2148	0.2781	0.3415
Sep-08	0.2157	0.2779	0.3401
Oct-08	0.2167	0.2777	0.3386
Nov-08	0.2188	0.2774	0.3361
Dec-08	0.2232	0.2772	0.3312

Figure 13. USAF & USA Time Series Prediction of Total CA-1 vs. Month

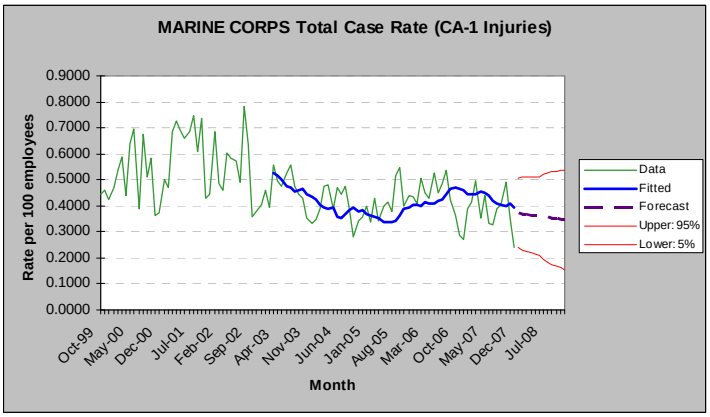


Trend: Seasonal (multiplicative) decreasing
Forecast: 0.03 rate decrease from Jan 08 to Dec 08
Service Comparison: Forecasts are seasonal with the highest rates occurring in March, May, August, and October. The USN has the lowest mean TCR of all the services at 0.23.

Method: Holt-Winters' Multiplicative
Parameters:
Alpha: 0.222
Beta: 0.017
Gamma: 0.473
Error: 0.01944
Series Statistics:
Mean: 0.2292
Std. Dev.: 0.0407
Minimum: 0.1459
Maximum: 0.3050

Forecast:

Date	Lower: 5%	Forecast	Upper: 95%
Jan-08	0.1522	0.1842	0.2162
Feb-08	0.1550	0.1879	0.2207
Mar-08	0.1817	0.2159	0.2502
Apr-08	0.1509	0.1870	0.2231
May-08	0.1681	0.2045	0.2408
Jun-08	0.1490	0.1857	0.2224
Jul-08	0.1458	0.1839	0.2219
Aug-08	0.1780	0.2159	0.2539
Sep-08	0.1501	0.1886	0.2271
Oct-08	0.1610	0.2006	0.2401
Nov-08	0.1346	0.1739	0.2132
Dec-08	0.1120	0.1534	0.1948



Trend: Decreasing
Forecast: 0.027 rate decrease from Jan 08 to Dec 08
Service Comparison: Highest mean TCR at 0.471 however has the smallest employee population and is forecasted to decrease at a strong rate as compared to other services. The 0.08 error is the largest of all services, which reflects the natural variation in the data due to small population size.

Method: Double Moving Average
Parameters:
Periods: 21
Error: 0.08111
Series Statistics:
Mean: 0.4705
Std. Dev.: 0.1160
Minimum: 0.2389
Maximum: 0.7834

Forecast:

Date	Lower: 5%	Forecast	Upper: 95%
Jan-08	0.2385	0.3730	0.5074
Feb-08	0.2281	0.3705	0.5129
Mar-08	0.2227	0.3680	0.5134
May-08	0.2143	0.3631	0.5118
Jun-08	0.2075	0.3606	0.5137
Jul-08	0.1962	0.3581	0.5200
Aug-08	0.1845	0.3557	0.5268
Sep-08	0.1758	0.3532	0.5306
Oct-08	0.1682	0.3507	0.5333
Nov-08	0.1620	0.3482	0.5345
Dec-08	0.1525	0.3458	0.5390

Figure 14. USN & USMC Time Series Predictions of Total CA-1 vs. Month

A comparison of the military services TCR reveals that the USN (0.23) has the lowest monthly TCR followed by the USAF (0.25), USA (0.29), and USMC (0.47). In 2000 through 2002, the USMC experienced high monthly rates peaking at 0.78 in August of 2002. During this month, the USMC experienced its highest rate of unclassified "cause of injury" at 0.15 (in comparison to a USMC mean of 0.06) and a high rate of manual handling of equipment "cause of injury" at 0.33 (compared to a USMC mean of 0.20). The USN and USMC are forecasted to decrease the most in 2008 with reductions of 0.031 and 0.027 respectively. The USA portrays the most stable of monthly case rates at 0.29 a month per 100 employees. Note that the standard deviation (or spread) for USMC TCR is three times higher than for the other services.

c. Time Series for "Causes of Injury"

Military service time-series predictions are generated for hazards as described by CA-1 injury source codes. Figure 15 provides a historical comparison on the number one injury throughout DoD, Manual Handling of Equipment.

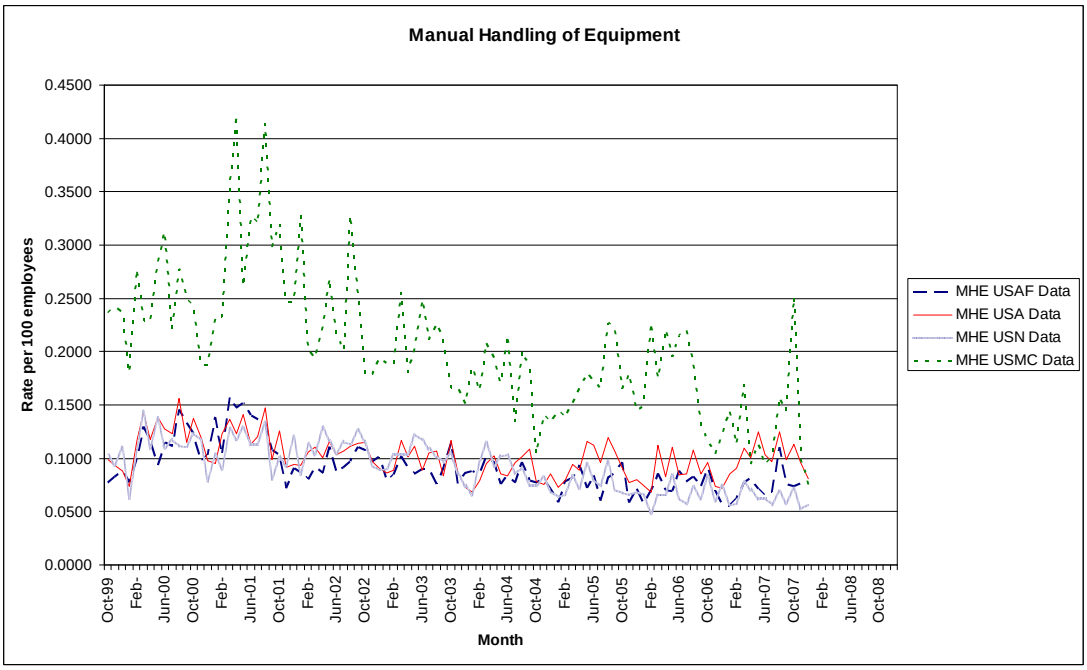
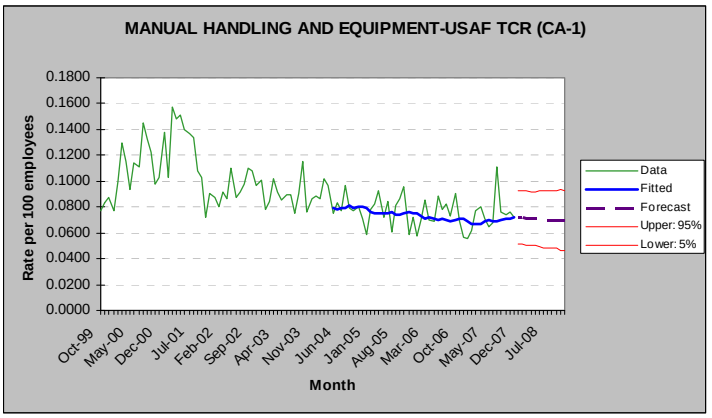


Figure 15. Manual Handling of Equipment by Service

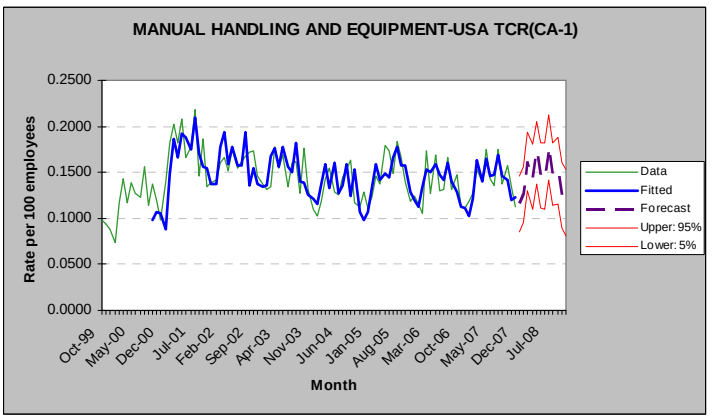
Notice the large magnitude in the USMC's rate of change over time and the similarity between the USN and USAF rates. Again, this is an example of more variation (data spread) due to a much smaller sample size in the USMC data. The disparity in variance is a byproduct of the smaller population of civilian employees in the USMC compared to other services. A closer look at time series prediction and forecasts, in Figures 16 and 17, shows that services overall are experiencing downward trends in manual handling of equipment injuries.



Method: Double Moving Average
Parameters:
Periods: 28
Error: 0.01225
Series Statistics:
Mean: 0.0909
Std. Dev.: 0.0224
Minimum: 0.0554
Maximum: 0.1574

USAF

Date	Lower: 5%	Forecast	Upper: 95%
Jan-08	0.0515	0.0718	0.0922
Feb-08	0.0510	0.0716	0.0923
Mar-08	0.0506	0.0714	0.0922
Apr-08	0.0509	0.0712	0.0915
May-08	0.0501	0.0710	0.0919
Jun-08	0.0494	0.0708	0.0922
Jul-08	0.0485	0.0706	0.0928
Aug-08	0.0480	0.0704	0.0928
Sep-08	0.0483	0.0702	0.0921
Oct-08	0.0480	0.0700	0.0921
Nov-08	0.0464	0.0698	0.0932
Dec-08	0.0464	0.0696	0.0929

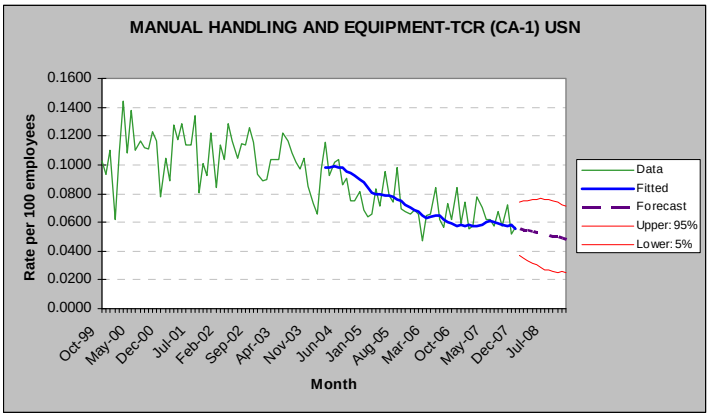


Method: Seasonal Additive
Parameters:
Alpha: 0.342
Gamma: 0.367
Error: 0.01832
Series Statistics:
Mean: 0.1432
Std. Dev.: 0.0270
Minimum: 0.0734
Maximum: 0.2180

USA

Date	Lower: 5%	Forecast	Upper: 95%
Jan-08	0.0698	0.0910	0.1122
Feb-08	0.0720	0.0927	0.1134
Mar-08	0.0953	0.1162	0.1371
Apr-08	0.0803	0.1026	0.1248
May-08	0.1020	0.1243	0.1466
Jun-08	0.0807	0.1036	0.1266
Jul-08	0.0764	0.1001	0.1237
Aug-08	0.1007	0.1241	0.1476
Sep-08	0.0788	0.1023	0.1258
Oct-08	0.0859	0.1101	0.1343
Nov-08	0.0676	0.0919	0.1162
Dec-08	0.0585	0.0834	0.1083

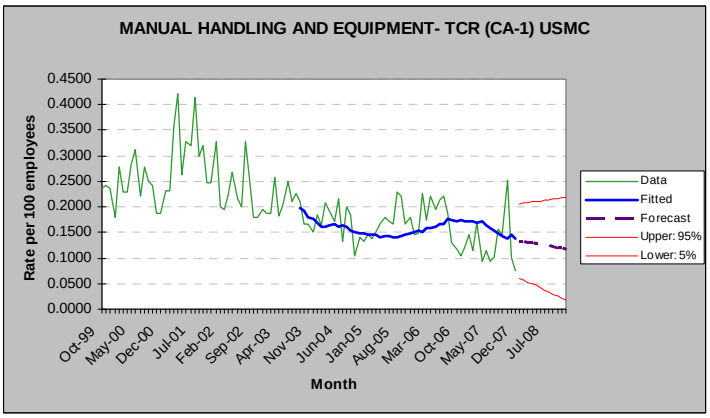
Figure 16. USAF & USA Manual Handling of Equipment Causes of Injuries



Method: Double Moving Average
Parameters:
Periods: 27
Error: 0.01145
Series Statistics:
Mean: 0.0906
Std. Dev.: 0.0233
Minimum: 0.0476
Maximum: 0.1444

USN

Date	Lower: 5%	Forecast	Upper: 95%
Jan-08	0.0370	0.0556	0.0742
Feb-08	0.0353	0.0549	0.0746
Mar-08	0.0333	0.0543	0.0752
Apr-08	0.0316	0.0536	0.0757
May-08	0.0302	0.0530	0.0757
Jun-08	0.0282	0.0523	0.0764
Jul-08	0.0273	0.0517	0.0760
Aug-08	0.0264	0.0510	0.0756
Sep-08	0.0256	0.0503	0.0751
Oct-08	0.0254	0.0497	0.0740
Nov-08	0.0256	0.0490	0.0725
Dec-08	0.0254	0.0484	0.0713



Method: Double Moving Average
Parameters:
Periods: 24
Error: 0.04389
Series Statistics:
Mean: 0.2036
Std. Dev.: 0.0670
Minimum: 0.0754
Maximum: 0.4218

USMC

Date	Lower: 5%	Forecast	Upper: 95%
Jan-08	0.0607	0.1335	0.2064
Feb-08	0.0570	0.1321	0.2072
Mar-08	0.0529	0.1307	0.2085
Apr-08	0.0492	0.1293	0.2095
May-08	0.0455	0.1279	0.2103
Jun-08	0.0414	0.1265	0.2117
Jul-08	0.0374	0.1251	0.2128
Aug-08	0.0329	0.1237	0.2145
Sep-08	0.0290	0.1223	0.2156
Oct-08	0.0253	0.1209	0.2165
Nov-08	0.0212	0.1195	0.2179
Dec-08	0.0182	0.1181	0.2180

Figure 17. USN & USMC Manual Handling of Equipment Causes of Injuries

The USAF forecasted range is the smallest of all the services. Seasonal characteristic are apparent in the Army's fitted and forecasted values. Additionally, due. to the seasonality, the Army's range (0.04) of the forecasted rates is the largest of all the services. The USN and USMC are analyzed in Figure17.

The USN's forecast is consistently decreasing at a slightly higher rate than the USMC's. All services have their lowest forecast in the month of December 2008. The USMC has the highest RMSE value of 0.04. The prediction threshold over 12 periods is the largest. The USMC standard deviation is more than three times larger than that of other services.

d. Time Series for "Injury Type"

Time series predictions are produced on injury types. Figure 18 plots a service comparison on the number one injury common in all the services, Minor Contusions, Bruises or Abrasions.

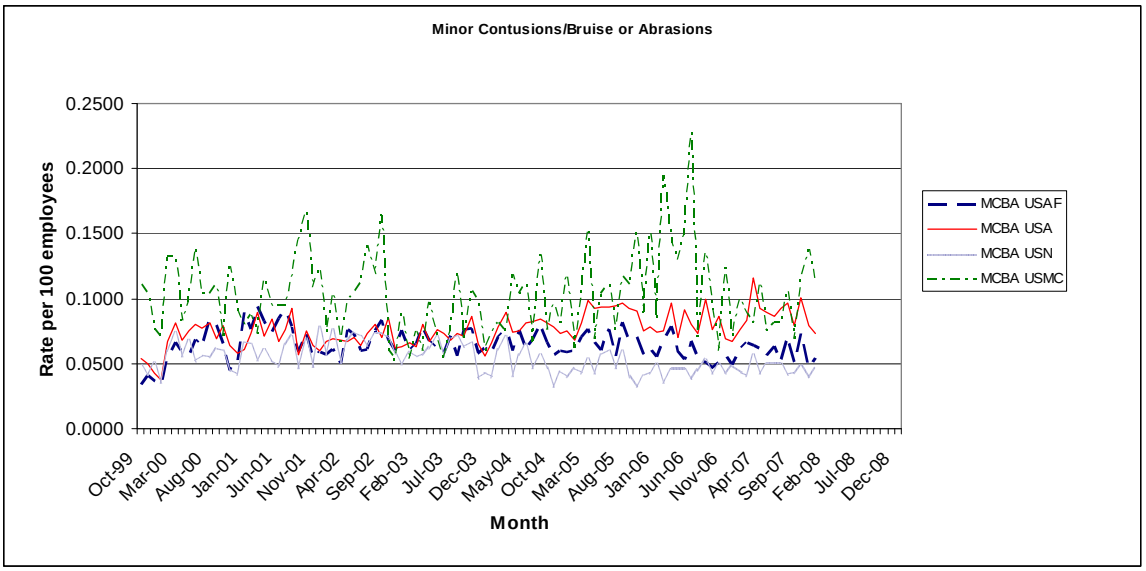
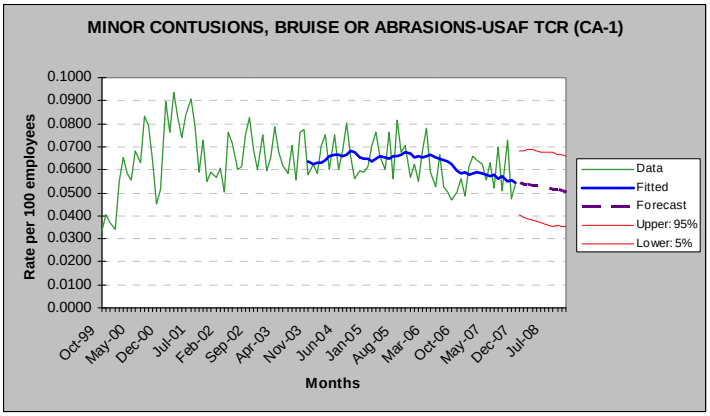


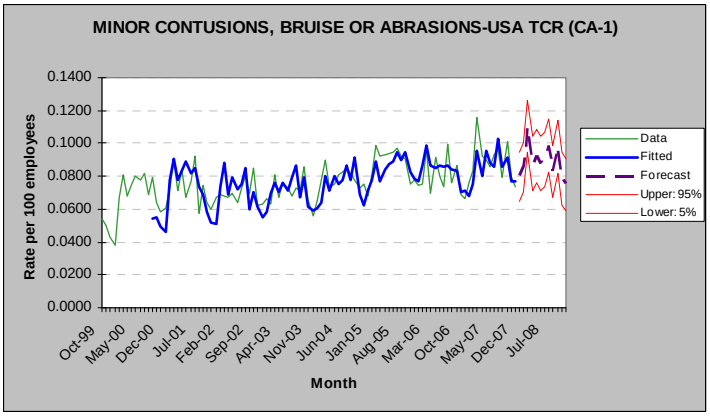
Figure 18. Minor Contusions, Bruise or Abrasions by Service

There is a noticeable spike in the USMC's June 2006 rate, which was 0.23 as compared to a mean of 0.10. During 2006, the USMC increased the employee population by 892 people and an increase is evident throughout 2006. Other services show a relatively steady rate. Figures 19 and 20 show the time series forecasts for Minor Contusions, Bruises or Abrasion. Again, the time series method producing the smallest error is shown.



Method: Double Moving Average
Parameters:
Periods: 25
Error: 0.008517
Series Statistics:
Mean: 0.0640
Std. Dev.: 0.0120
Minimum: 0.0337
Maximum: 0.0935

Date	Lower: 5%	Forecast	Upper: 95%
Jan-08	0.0402	0.0543	0.0683
Feb-08	0.0394	0.0539	0.0684
Mar-08	0.0385	0.0536	0.0687
Apr-08	0.0379	0.0532	0.0686
May-08	0.0376	0.0529	0.0682
Jun-08	0.0372	0.0526	0.0679
Jul-08	0.0367	0.0522	0.0678
Aug-08	0.0360	0.0519	0.0678
Sep-08	0.0355	0.0516	0.0676
Oct-08	0.0357	0.0512	0.0667
Nov-08	0.0355	0.0509	0.0663
Dec-08	0.0351	0.0505	0.0660

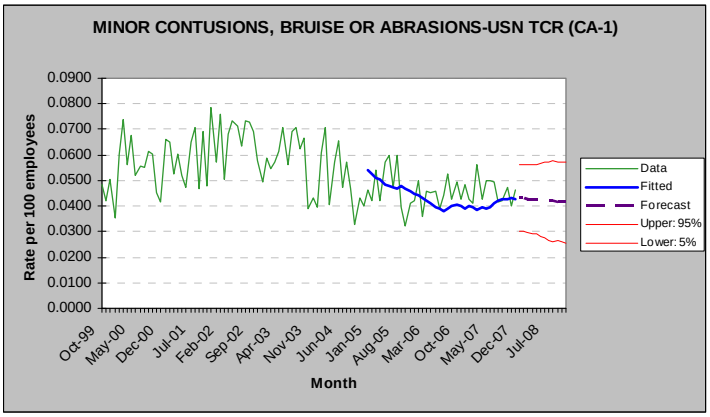


Method: Holt-Winters' Additive
Parameters:
Alpha: 0.183
Beta: 0.001
Gamma: 0.600
Error: 0.009020
Series Statistics:
Mean: 0.0763
Std. Dev.: 0.0129
Minimum: 0.0378
Maximum: 0.1155

Date	Lower: 5%	Forecast	Upper: 95%
Jan-08	0.0650	0.0798	0.0947
Feb-08	0.0706	0.0856	0.1007
Mar-08	0.0949	0.1104	0.1259
Apr-08	0.0714	0.0877	0.1040
May-08	0.0760	0.0920	0.1081
Jun-08	0.0712	0.0877	0.1042
Jul-08	0.0736	0.0901	0.1065
Aug-08	0.0827	0.0988	0.1149
Sep-08	0.0670	0.0830	0.0990
Oct-08	0.0818	0.0979	0.1139
Nov-08	0.0621	0.0783	0.0944
Dec-08	0.0588	0.0749	0.0910

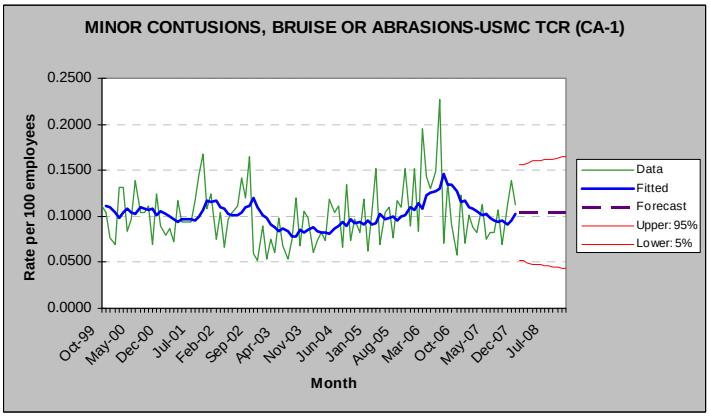
Figure 19. USAF & USA Minor Contusion, Bruise or Abrasions Injury Type

The USAF trend decreases the most of all services in 2008. The USA forecast is seasonal in nature and experiences the highest rates in March, August, and October and therefore the forecasts for the USA are highest during these months.



Method: Double Moving Average
Parameters:
Periods: 32
Error: 0.007833
Series Statistics:
Mean: 0.0533
Std. Dev.: 0.0113
Minimum: 0.0324
Maximum: 0.0786

Date	Lower: 5%	Forecast	Upper: 95%
Jan-08	0.0304	0.0432	0.0561
Feb-08	0.0302	0.0431	0.0560
Mar-08	0.0296	0.0429	0.0562
Apr-08	0.0292	0.0427	0.0563
May-08	0.0289	0.0426	0.0563
Jun-08	0.0282	0.0424	0.0567
Jul-08	0.0275	0.0422	0.0570
Aug-08	0.0267	0.0421	0.0574
Sep-08	0.0262	0.0419	0.0576
Oct-08	0.0264	0.0418	0.0571
Nov-08	0.0258	0.0416	0.0574
Dec-08	0.0255	0.0414	0.0573



Method: Single Exponential Smoothing
Parameters:
Alpha: 0.165
Error: 0.03156
Series Statistics:
Mean: 0.1015
Std. Dev.: 0.0316
Minimum: 0.0522
Maximum: 0.2275

Date	Lower: 5%	Forecast	Upper: 95%
Jan-08	0.0517	0.1039	0.1561
Feb-08	0.0515	0.1039	0.1562
Mar-08	0.0497	0.1039	0.1581
Apr-08	0.0480	0.1039	0.1597
May-08	0.0470	0.1039	0.1608
Jun-08	0.0470	0.1039	0.1608
Jul-08	0.0462	0.1039	0.1616
Aug-08	0.0459	0.1039	0.1618
Sep-08	0.0452	0.1039	0.1626
Oct-08	0.0442	0.1039	0.1636
Nov-08	0.0432	0.1039	0.1645
Dec-08	0.0429	0.1039	0.1649

Figure 20. USN & USMC Minor Contusion, Bruise or Abrasions Injury Type

The USN has the lowest monthly rate with a mean of 0.05 and the trend is slightly decreasing over time. The USMC rate is the highest with a mean of 0.10. The USMC thresholds also have a wider prediction range. In all three injury types shown, USMC standard deviation for TCR was about 300% of the observed standard deviation in other services.

e. USMC Time Series Predictions

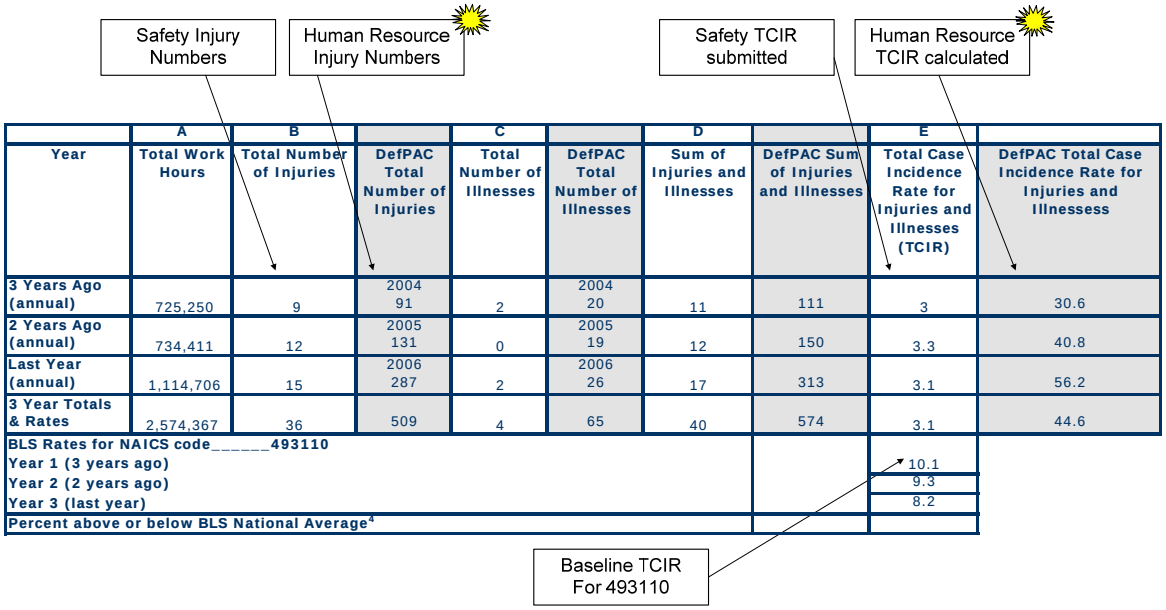
Time series predictions and injury thresholds for pertinent USMC "cause of injury" and "injury type" are provided in Appendices B and C. The reports provide a reference for HQMC SD while monitoring injuries occurring during a specific period. Reports are prepared each month; however, they may be modified to summarize quarterly numbers. Injury counts are provided instead of rates to provide a comparison to the DefPAC (human resource) database. With the reports and actual DefPAC data, performance is measured through the difference in actual data and forecasted or mishap reduction goals. Reports provided on an annual cycle ensure data is updated and models are constructed with the latest information.

4. VPP

As mentioned in Chapter II, VPP is a program that assists organizations in lowering their TCIR through an application-based program. Acceptance into the VPP requires a review of an application prepared by the installation. After OSHA officials review the application and conduct an on-site audit, an installation is assigned a rating (star, merit, or demonstration). The rating is based on a comparison of TCIR to civilian industry standards (NAIC and SIC industry codes) and the results of the on-site audit. MCLB Barstow recently received a star rating (the highest rating) for their VPP package. Their application was compared to NAICS code 493110 (General Warehouse Storing) and SIC 4225 (establishments primarily engaged in the warehousing and storage of a general line of goods).

a. MCLB Barstow VPP

Figure 21 displays MCLB Barstow's TCIR numbers as calculated by safety entities (in columns B, C, D, and E). The shaded area provides DefPAC (human resource) case numbers and is displayed next to the VPP package numbers. The TCIR metric is also calculated using DefPAC data.



	A	B		C		D		E	
Year	Total Work Hours	Total Number of Injuries	DefPAC Total Number of Injuries	Total Number of Illnesses	DefPAC Total Number of Illnesses	Sum of Injuries and Illnesses	DefPAC Sum of Injuries and Illnesses	Total Case Incidence Rate for Injuries and Illnesses (TCIR)	DefPAC Total Case Incidence Rate for Injuries and Illnessess
3 Years Ago (annual)	725,250	9	2004 91	2	2004 20	11	111	3	30.6
2 Years Ago (annual)	734,411	12	2005 131	0	2005 19	12	150	3.3	40.8
Last Year (annual)	1,114,706	15	2006 287	2	2006 26	17	313	3.1	56.2
3 Year Totals & Rates	2,574,367	36	509	4	65	40	574	3.1	44.6
BLS Rates for NAICS code_____493110									
Year 1 (3 years ago)								10.1	
Year 2 (2 years ago)								9.3	
Year 3 (last year)								8.2	
Percent above or below BLS National Average[4]									

Figure 21. MCLB Barstow VPP Package Compared to OWCP Totals

A subset of the CA-1 and CA-2 (illness claim form) were used for MCLB Barstow's 2007 VPP package. The values used for the safety numbers are approximately 10% of the human resource numbers. The differences highlight the necessity for data between safety and human resource to be cross-checked when reporting a safety metric. Additional safety programs help reduce TCIR and DART metrics over time, as compared to civilian industries. However, VPP programs need to be statistically assessed in the future to determine if they are affecting DoD safety metrics.

IV. RECOMMENDATIONS

Based on the process for tracking a civilian employee's injury claim and analyses, the following recommendations are provided to improve the injury tracking process and future analysis of injury data:

1. Select and use one common database that spans DoD and DoL. In particular, DefPAC can serve as the common data source for both safety and human resources for tracking injury claims and data.
2. Establish a forum within the injury tracking process to communicate and crosscheck injury data. In particular, establish a "FECA Council" at each installation to ensure SMs and ICPAs are consistently tracking and updating injuries.
3. Use time series methods to measure and project future performance. Promote safety audit programs such as VPP to aid in refining safety programs.
4. Improve the recordkeeping process so that more detailed data is available to analyze injury trends and causes. In particular, define the OSHA site code on the CA-1 form to map to an installation's safety department. Add this field to DefPAC (e.g., "Safety Liaison").

A. SELECT A COMMON INJURY ANALYSIS DATABASE FOR SAFETY AND HUMAN RESOURCES

The fundamental and necessary data exist in the DefPAC database to track and analyze hazards and injury types. However, the DMDC LWD and LWDR metrics have overshadowed injury data in spite of the fact that DefPAC injury data can be used to provide additional insight into causal factors for injury rates.

The benefit of using DefPAC over a new system such as DSES is that injury and source codes are common for both DoL and DoD. The creation of DSES and new SDEs may add new variables and potentially additional sets of data and metrics. These new metrics may introduce standardization problems between DoL and DoD.

Regardless of which system is ultimately used, one common database must be used to span DoD and DoL as well as functional (safety manager and human resources) boundaries.

B. ESTABLISH INSTALLATION FECA COUNCILS FOR SAFETY AND HUMAN RESOURCES

The use of a FECA Council provides a forum for safety and human resource departments to communicate and crosscheck appropriated civilian employee injury data. Figure 22 shows where the FECA Council would fit into the existing process. This recommendation follows from the study done by NAS in 2004 (described in Chapter I).

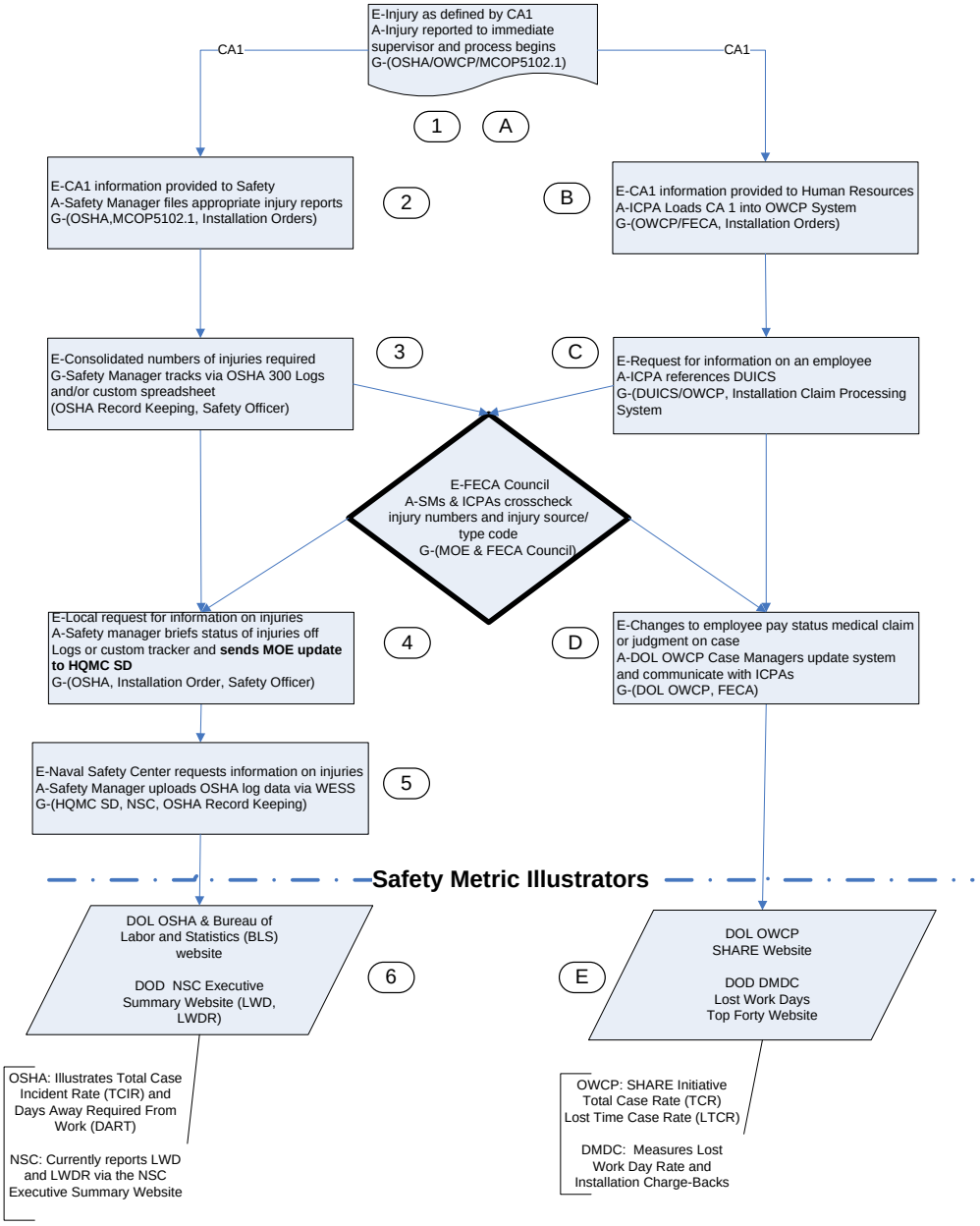


Figure 22. New Tracking Process Recommendation: Add a FECA Council.

A FECA Council ensures both the SMs and ICPAs are updating injuries consistently and eliminates a competing database environment. The Army uses a FECA Working Group that has the following charter and structure:

> The Installation Working Group consists of safety, civilian personnel, occupational health, resource management, legal, CIDC and others. The installation commander chairs it. The primary role is to review compensation cases, costs and accidents and to devise steps aimed at

> reducing the number of claims, costs and lost work time. Emphasis is placed on efforts to return injured employees to productive employment, to controvert questionable injury and occupational illness claims and to implement accident prevention initiatives. Every installation must have a FECA Working Group, even if the annual program cost is less than one million Dollars (CPOL, 2006).

The USA requires the installation commander to chair the FECA Working Group; however, the installation comptroller would be an appropriate chair for USMC installations. A comptroller is able to appreciate the importance of tracking injuries due to his or her familiarity with chargeback fees and close relationship with installation Commanding and Executive Officers.

C. TIME SERIES ANALYSIS AND ADDITIONAL SAFETY PROGRAMS

1. Time Series Analysis

Time series analyses on injury data provide an additional component to the existing safety analyses by using historical injury data to deliver insight into future injury trends. In addition, when compared to actual injury data, time series predictions and their associated confidence intervals can be used to identify unusual data points that should be further investigated. Hence, the use of time series methods, such as those presented in Chapter III and Appendices B and C, will give Marine Corps leadership and safety managers insight into performance trends, both historical and projected. They will also give leadership a quantitative basis for appropriately assessing the Marine Corps' progress towards attaining programmatic goals.

2. VPP Program

In addition to time series analysis, additional audits and safety enhancement programs, such as VPP, help reduce injuries by having subject matter experts review safety systems. No statistically equivalent civilian industry can represent the USMC civilian employee population and mission for comparison. VPP provides a civilian industry, within a NAIC or SIC, to use as a baseline (the ability to compare to like

industries) for performance. Once the specific location of an injury is added to the DefPAC database, the USMC should use injury data to baseline within their own organization. The use of additional statistical process controls and an internal baseline of USMC injury case performance are solid topics for future research

D. FORM AND DATA HANDLING RECOMMENDATIONS

A review of the existing forms and logs used to track data reveal the need to define the OSHA site code on a CA-1 form. Additionally, OSHA log data is not sufficient for injury analysis at the macro level due to the lack of categorical injury data.

1. Federal Employees' Notice of Injury and Claim for Continuation of Pay Compensation (CA-1) Form

The CA-1 form (Figure 23) is the initial source of information for all injuries and illnesses for both safety and human resources. The injured employee or someone acting in the employee's behalf (e.g., witness or supervisor) prepares the CA-1. The purpose of the CA-1 is to establish a case on the current injury and to provide a reference for future medical claims.

One of the reasons data is inconsistent between safety and human resources is due to the lack of clarity in filling out the OSHA site code (item 17, pointed out in Figure 23). The Resource Book for Federal Employing Agency Compensation Specialist (CS), states the following guidance on how to fill out item 17, (OSHA Site Code):

> Leave Blank. This code will be used to identify agency locations where injuries occur. OSHA is using the [OWCP] agency code and duty station zip code to identify injury locations. OSHA may later require that agencies develop OSHA site codes. Also, agencies may, with OSHA assistance, develop OSHA site codes on their own initiative (DoL, 1999).

This study reveals that CS at other agencies such as the U.S. Border Patrol and Air Force National Guard use Unit Identification Codes (UIC) as entries for the OSHA site code. A visit to the OSHA site office verified that the U.S. military does not have a

set of unique OSHA site codes. Additionally, there is no specific guidance delineating the appropriate procedure, for ICPAs to use when filling out item 17 for military services.

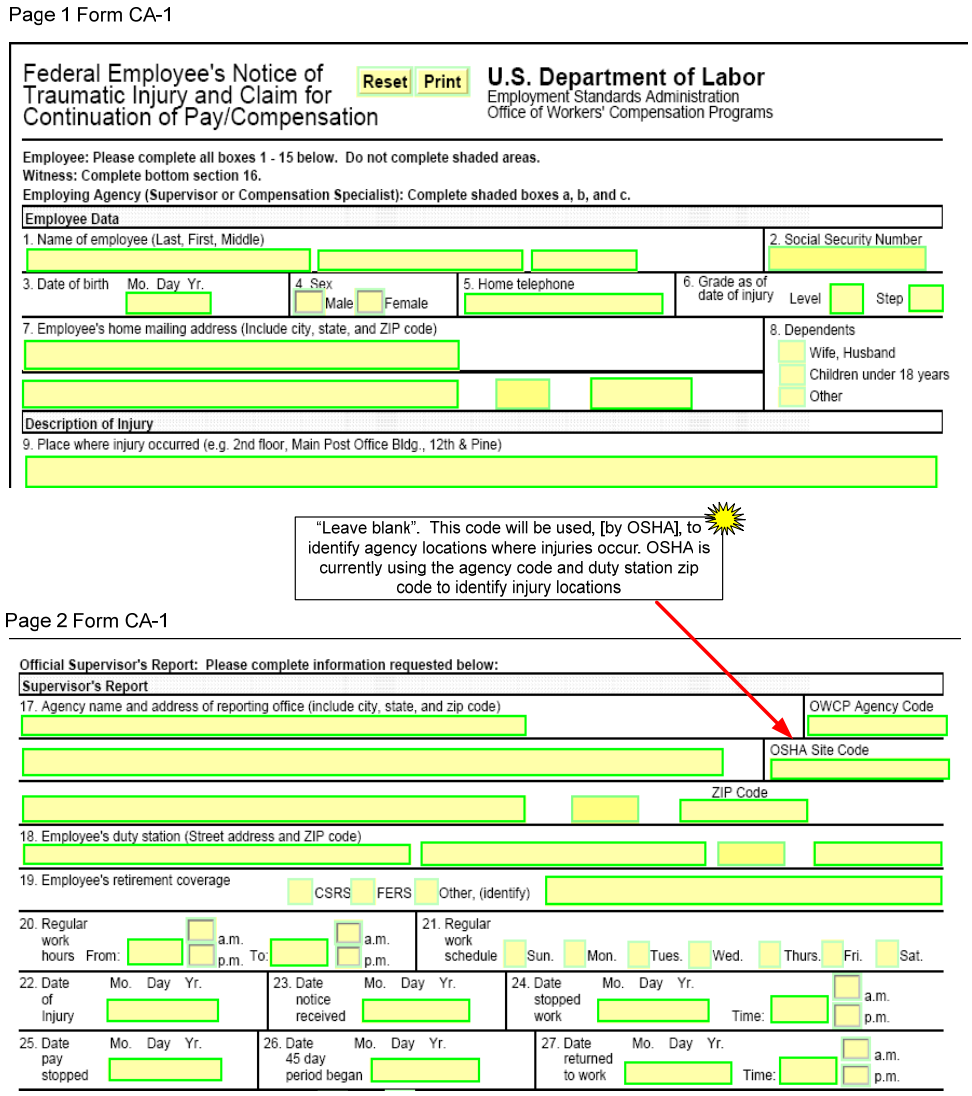


Figure 23. CA-1 Form with Comments on OSHA and OWCP Codes From (OWCP, 2008)

The lack of an OSHA site code limits the ability for safety entities to link data to both safety and human resource organizational entities.

2. OWCP Codes

a. Injury Type and Source Codes

Figure 24 illustrates where injury source and type codes are located on the CA-1. The compensation training manual provides a categorical coding system for injury types and sources for ICPAs to use when filling out a CA-1. The codes are available at OWCP's national website (in the appendix B of the Injury Compensation for Federal Employees Publication-CA-810). If DoD wishes to streamline their systems and formulate SDEs, collaboration with DoL is essential, as is an integrated review of the CA-1 Form. New SDEs must be phased into the CA-1 form. Another option is to use the current codes provided by the DoL and focus on minimizing the Unclassified category. Injury codes must be used by all entities to ensure consistency.

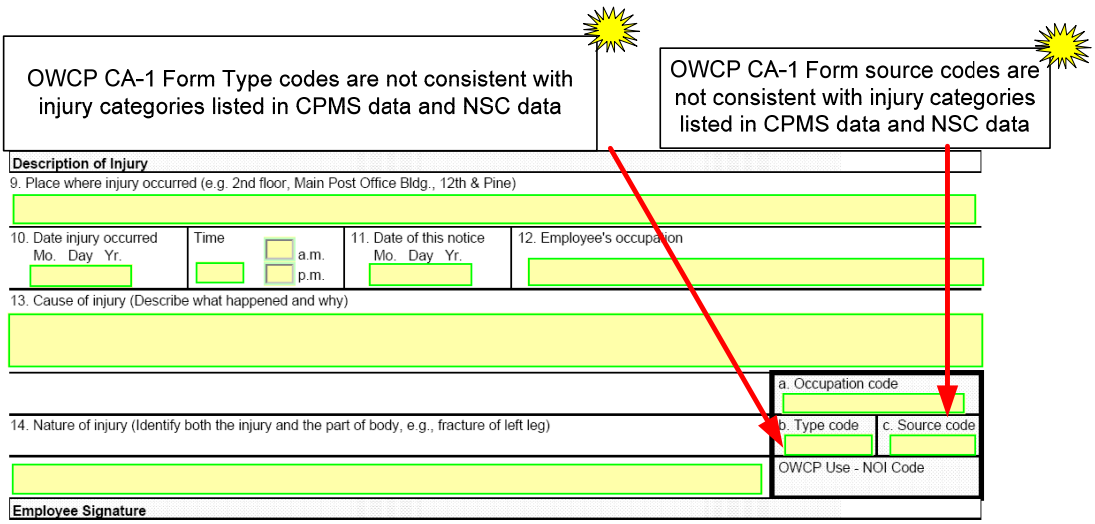


Figure 24. CA-1 Description of Injury and Illness Type and Source Codes From (OWCP, 2008)

b. Chargeback Codes

The OWCP agency code, is the "chargeback code" associated with the chargeback fees discussed in Chapter I and is also located in item 17. Figure 25

highlights OWCP agency code on the CA-1 form. Referencing the training manual for ICPAs the following guidance is given for item, 17 OWCP agency code:

> Item 17: OWCP Agency Code- (sometimes called "chargeback code"); enter if omitted. This is the four-digit (or four-digit plus two letter) code OWCP uses to identify the employing agency. The code is used for charging costs of the injury to the responsible agency. OSHA also uses it to identify injury locations. If after the CA-1 is forwarded to OWCP, the CS finds that the agency code was incorrect, the CS should immediately contact OWCP and ask to have the code corrected. It is very important to use the correct code (DoL, 1999).

Recall the OSHA site code guidance, which is adjacent the OWCP agency code, was to leave the OSHA site code blank. Another comment on the OSHA site code is evident in the "Employee's duty station (Street address and ZIP code)," item 18, described in Figure 25.

> Item 18: Verify the employee's duty station, including street address and zip code, is correct. The zip code is very important as it may be used as the OSHA site code (DoL, 1999).

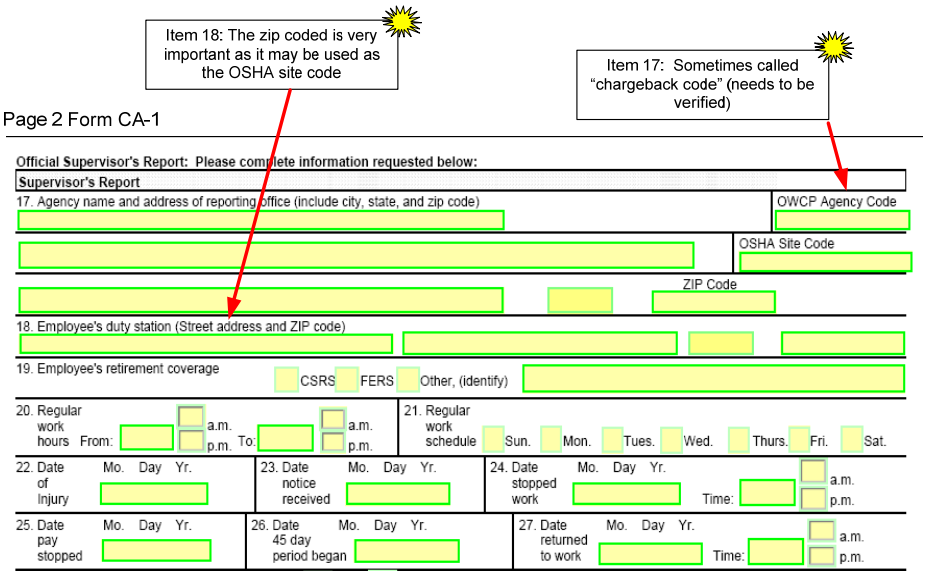


Figure 25. CA-1 Description of OWCP Agency Code and Employee duty station From (OWCP, 2008)

The lack of consistency and guidance to track OSHA site codes contributes to different data within safety and human resource databases as identified in previous studies.

Clarification on how to use the OSHA site code on the CA-1 form enables DoD to track where injuries occur. Using a UIC as the OSHA site code simplifies the process, prevents additional numbering conventions, and is one option. On the other hand, USMC safety departments are responsible for multiple UICs and a list of UICs in the DefPAC database congests the database. Figure 26 recommends a "Safety Liaison" OSHA site code convention, which correlates human resource and safety data:

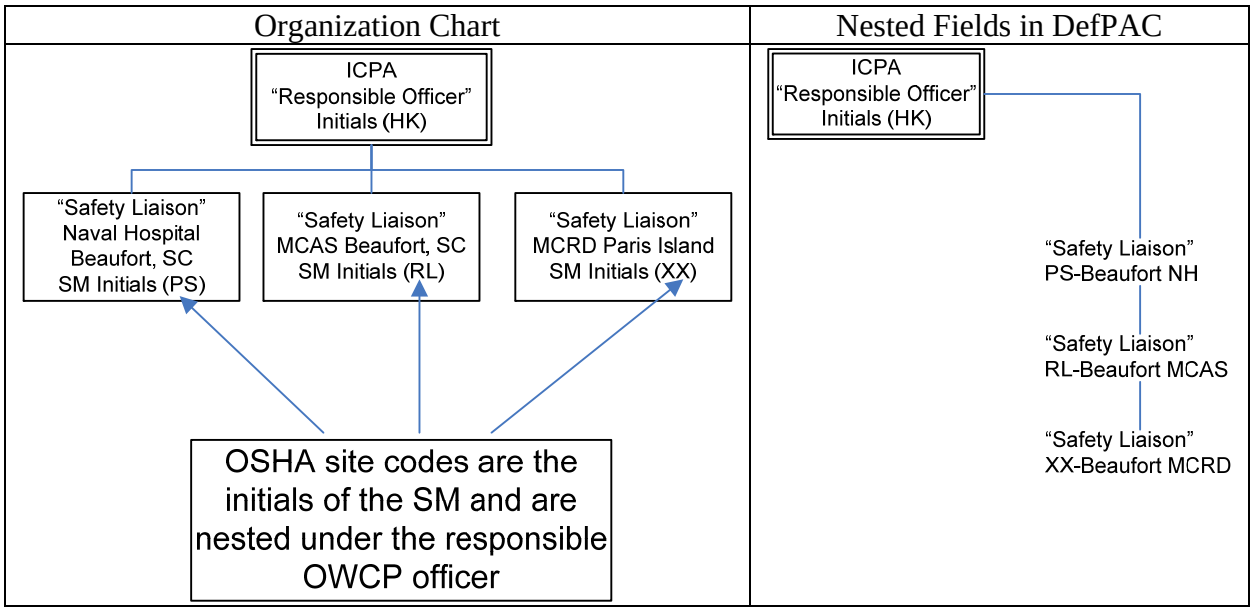


Figure 26. OSHA Site Code Recommendation

DefPAC data currently uses "Responsible Officer" initials to nest and map injury claim data to an OWCP officer. Using a SM's initials not only maps an injury to a safety department location but also maintains the existing convention. During a FECA Council ICPAs and SMs are able to crosscheck injury data by using one database. With the location of the injury being tracked, focus shifts to ensuring all injuries are accounted for and the detailed categorization of injuries.

3. OSHA Forms and Logs

Without the previously described convention, SMs typically maintain a custom spreadsheet which helps track both active duty military injuries as a well as civilian employee injuries. OSHA requires SMs to maintain information on injuries via a log and reporting form system described below. The OSHA log and reporting system does not possess sufficient categorical injury data for analysis.

a. OSHA Form 300 Log or Work-Related Injuries and Illnesses

OSHA Form 300 (Figure 27) classifies work-related injuries and illnesses and documents the extent and severity of each case. Installations are required to maintain an OSHA 300 log. The description of the injury and illness in field (F) is more subjective than categorical.

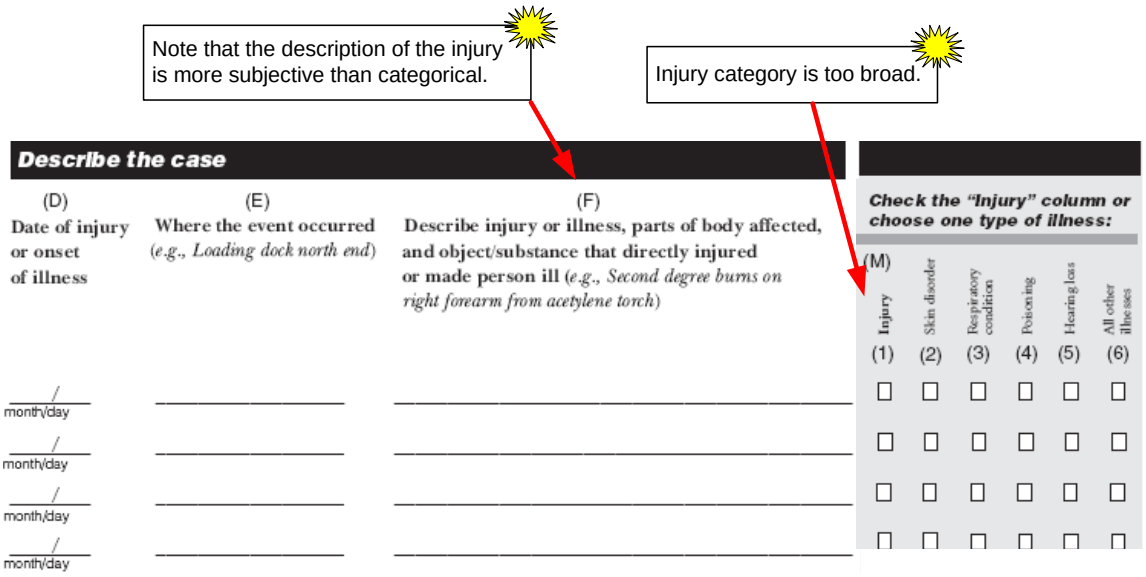


Figure 27. OSHA 300 Log Injury Description Field and Categories From (OSHA, 2008)

To identify and analyze trends associated with injuries, logs need to contain data that are more categorical.

b. OSHA Form 300A Summary of Work-Related Injuries and Illnesses

OSHA Form 300A (Figure 28) shows the work-related injury amounts based on the OSHA 300 log. Lack of detail on an OSHA 300 log transfers to the summary document. Form 300A is posted where employees are made aware of the injuries and illnesses occurring in their workplace.

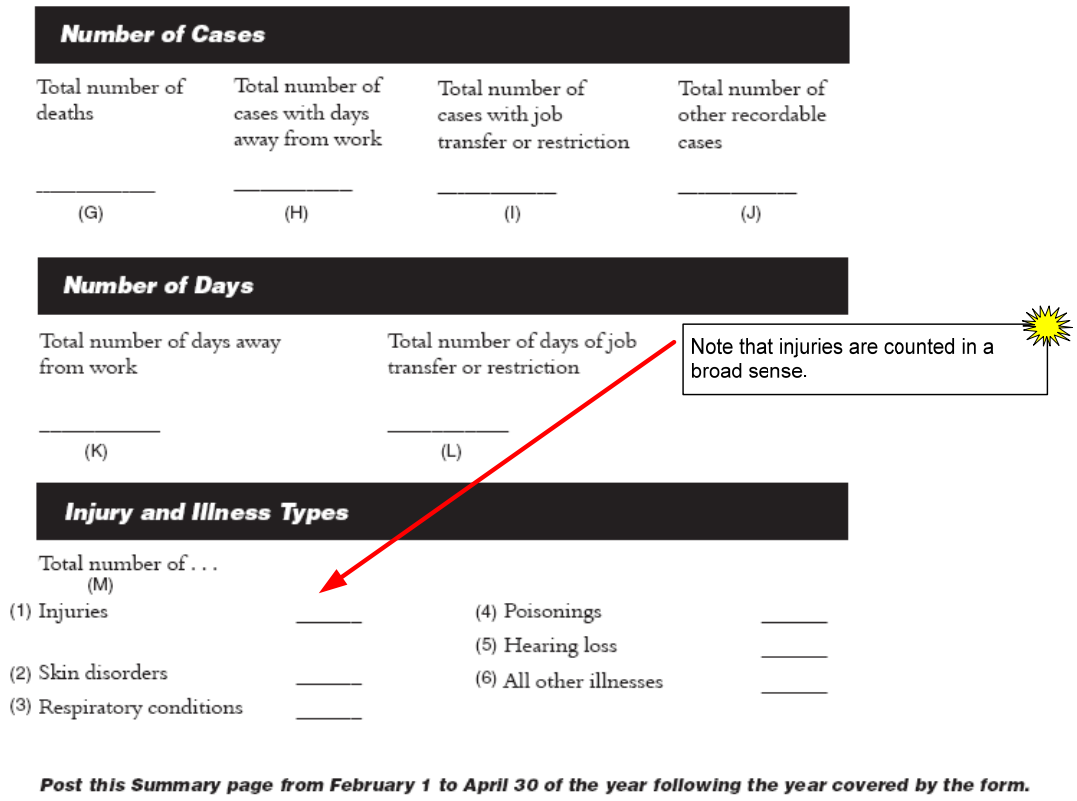
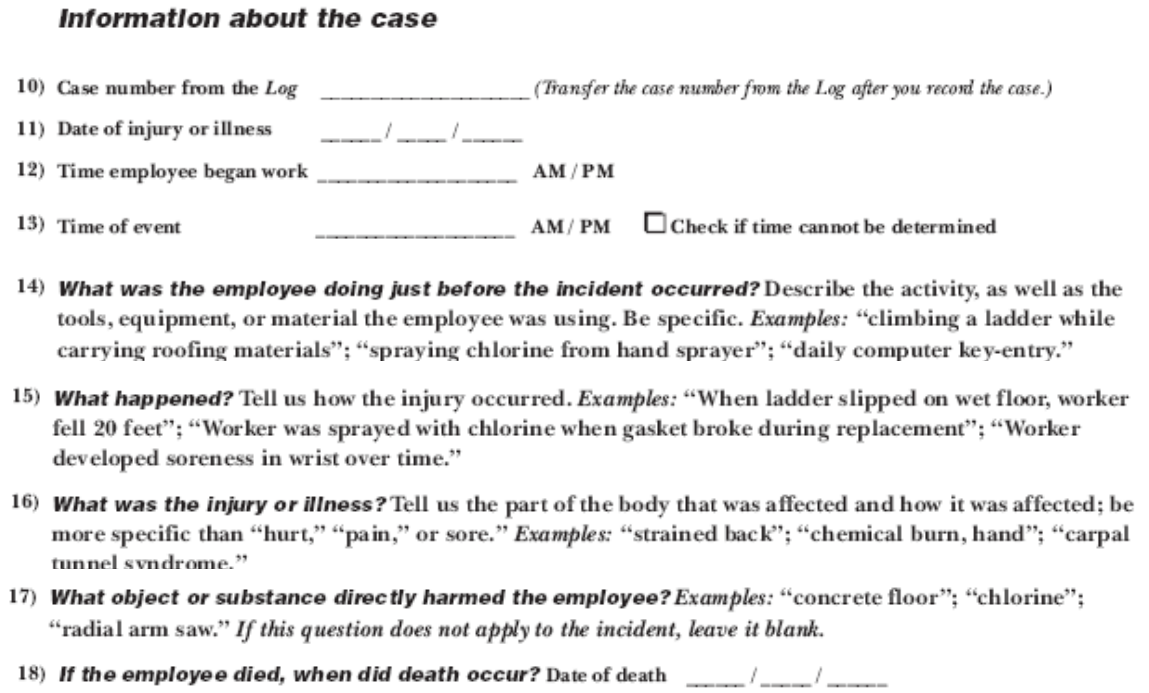


Figure 28. OSHA Form 300A Summary Information From (OSHA, 2008)

The OSHA Form 300A only provides three injury categories. After every injury, an installation is required to submit an incident report in the form of an OSHA Form 301.

c. OSHA Form 301 Injury and Illness Incident Report

OSHA Form 301 (Figure 29) is filled out when an employee is injured on the job. With OSHA Forms 300, 301, and 301, OSHA states an overview of work-related injuries are provided.



Information about the case

10) Case number from the *Log* _____ *(Transfer the case number from the Log after you record the case.)*

11) Date of injury or illness _____ / _____ / _____

12) Time employee began work _____ AM / PM

13) Time of event _____ AM / PM ☐ Check if time cannot be determined

14) ***What was the employee doing just before the incident occurred?*** Describe the activity, as well as the tools, equipment, or material the employee was using. Be specific. *Examples:* "climbing a ladder while carrying roofing materials"; "spraying chlorine from hand sprayer"; "daily computer key-entry."

15) ***What happened?*** Tell us how the injury occurred. *Examples:* "When ladder slipped on wet floor, worker fell 20 feet"; "Worker was sprayed with chlorine when gasket broke during replacement"; "Worker developed soreness in wrist over time."

16) ***What was the injury or illness?*** Tell us the part of the body that was affected and how it was affected; be more specific than "hurt," "pain," or sore." *Examples:* "strained back"; "chemical burn, hand"; "carpal tunnel syndrome."

17) ***What object or substance directly harmed the employee?*** *Examples:* "concrete floor"; "chlorine"; "radial arm saw." *If this question does not apply to the incident, leave it blank.*

18) ***If the employee died, when did death occur?*** Date of death _____ / _____ / _____

Figure 29. OSHA 301 Form Summary Information From (OSHA, 2008)

It is difficult to categorize injuries using text fields 14-17 in Figure 29. Local installations gain insight on a specific injury; however, data analysis at the macro level is not practically achievable.

An OSHA-based system provides guidance on how to track and report injuries; however, there are too few injury categories for analysis. The ability to statistically analyze injuries by injury type does not exist in the OSHA system. On the other hand, human resources possess injury source and type codes, as well as a chargeback fee code discussed earlier.

APPENDIX A. SAFETY METRIC FORMULAS

A. DMDC LWD/LWDR FORMULAS

1. Definitions

Continuation of Pay (COP): COP is an agency paid benefit. The benefit is paid to the employee via their regular paycheck rather than an Office of Workers' Compensation Programs (OWCP) generated payment. Even though the agency administers this benefit, OWCP is the final authority on COP. The agency is bound to follow OWCP direction regarding payment of COP. If the employee is temporarily disabled from 0 to 45 days, he or she is entitled to COP. In this case, the employing agency is responsible for compensation only up to 45 days.

Leave Without Pay (LWOP): If the disability extends beyond the initial 45 days, the employee goes into a "non-paid status" called LWOP. However, civilian employees are entitled to use sick leave at this time.

2. Lost Work Days (LWD) Formula

Represents the number of hours an employee is on COP plus the number hours they are in a LWOP status. Note that this variable is a range as opposed to a discrete value. The indices represent an employee and pay period respectively.

$i =$ **index for employee**

$j =$ **index for pay period**

$$\textbf{prorated days} = \textit{regular days} + \textit{sick leave} + \textit{annual leave} + \textit{COP days} + \textit{LWOP days}$$

$$LWD = \sum_{j}\sum_{i}(COP_{ij} + LWOP_{ij})$$

3. Lost Work Day Rate (LWDR) Formula

LWD Rate per 100 employees is the primary measure for DMDC:

$$LWD_{rate} = \frac{\sum_{j}\sum_{i}(COP_{ij} + LWOP_{ij})}{\sum_{j}\sum_{i}\textbf{prorated days}_{ij}} x20,000$$

B. SHARE INITIATIVE FORMULAS

1. Total Case Rate (TCR) Formula

The Total Case Rate (TCR) is calculated by dividing the number of total cases by the number of employees. The resulting number is then multiplied by 100, for a rate per 100 employees:

$$TCR = \frac{Total\ Cases\ Submitted\ to\ OWCP}{Number\ of\ Employees} x100$$

2. Lost Time Case Rate (LTCR) Formula

Lost Time Case Rate (LTCR) is calculated separately by dividing the number of lost time cases by the number of employees. The resulting number is then multiplied by 100, for a rate per 100 employees:

$$LTCR = \frac{Lost\ Time\ Total\ Cases\ Submitted\ to\ OWCP}{Number\ of\ Employees} x100$$

C. OSHA SAFETY METRIC FORMULAS

1. Total Case Incident Rate (TCIR) Formula

$$TCIR = \left(\frac{N}{EH}\right) * 200,000$$

N = Sum of the number of recordable non-fatal injuries plus illnesses in a given time frame (either 1 year for an annual rate or 3 years for 3-year combined rate)

EH= Total number of hours worked by all employees, appropriated and non-appropriated, in a given time frame (either 1 year for an annual rate or 3 years for 3-year combined rate)

200,000 = Equivalent of 100 full-time workers working 40-hours per week, 50 weeks per year

2. Days Away from Work, Restricted or Transfer (DART) Formula

$$DART = \left(\frac{N}{EH} \right) * 200,000$$

N = Sum of the number of recordable non-fatal injuries plus illnesses resulting in days away from work in a given time frame (either 1 year for an annual rate or 3 years for 3-year combined rate)

EH= Total number of hours worked by all employees, appropriated and non-appropriated, in a given time frame (either 1 year for an annual rate or 3 years for 3-year combined rate)

200,000 = Equivalent of 100 full-time workers working 40-hours per week, 50 weeks per year

These formulas were taken from the OSHA Voluntary Protection Program (VPP) application (OSHA DoL, 2008). Additionally, these formulas are also used to qualify a base for the OSHA Voluntary Protection Program.

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APPENDIX B. USMC "CAUSE OF INJURY" TIME SERIES PREDICTION

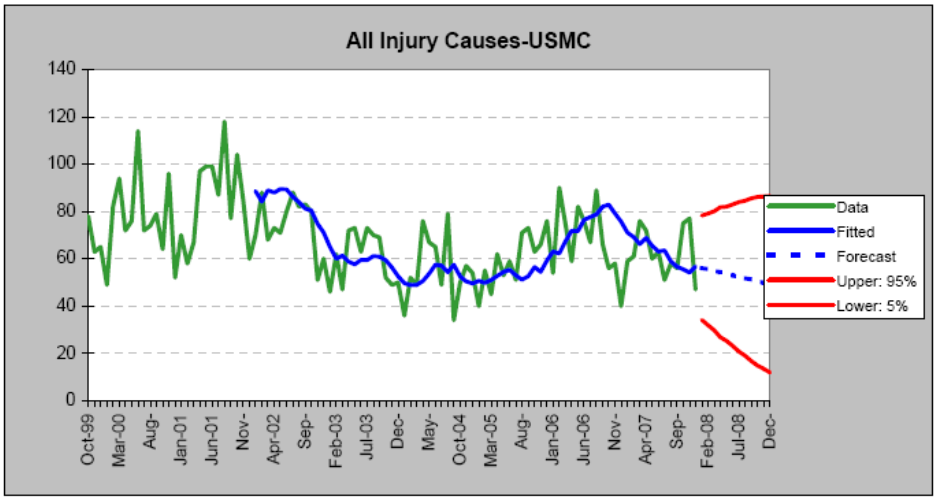
Series: All Injury Causes-USMC **Range: C18:CW18**

Method: Double Moving Average
Parameters:
Periods: 14
Error: 13.492

Series Statistics:
Mean: 68
Std. Dev.: 16
Minimum: 34
Maximum: 118
Ljung-Box: 131.1471

Forecast:

Date	Lower: 5%	Forecast	Upper: 95%
Jan-08	34	56	78
Feb-08	32	56	79
Mar-08	30	55	80
Apr-08	27	54	82
May-08	25	54	82
Jun-08	23	53	83
Jul-08	21	52	84
Aug-08	19	52	85
Sep-08	17	51	86
Oct-08	15	51	86
Nov-08	13	50	86
Dec-08	12	49	87



Created: 5/7/2008 at 9:27:32 PM

Summary:

Number of series: 50
Periods to forecast: 12
Seasonality: 12 months
Error Measure: RMSE

USMC "CAUSE OF INJURY" and "INJURY TYPE" THRESHOLDS THROUGH DECEMBER 2008

Series: ANIMAL BITES-USMC **Range: C3:CW3**

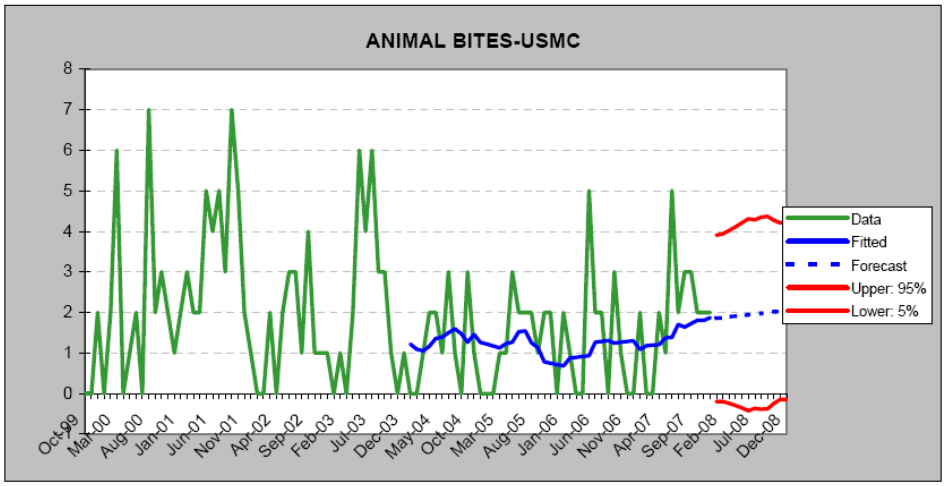
Method: Double Moving Average
Parameters:
Periods: 26
Error: 1.2446

-High values during summer months

Series Statistics:
Mean: 2
Std. Dev.: 2
Minimum: 0
Maximum: 7
Ljung-Box: 89.8360

Forecast:

Date	Lower: 5%	Forecast	Upper: 95%
Jan-08	0	2	4
Feb-08	0	2	4
Mar-08	0	2	4
Apr-08	0	2	4
May-08	0	2	4
Jun-08	0	2	4
Jul-08	0	2	4
Aug-08	0	2	4
Sep-08	0	2	4
Oct-08	0	2	4
Nov-08	0	2	4
Dec-08	0	2	4



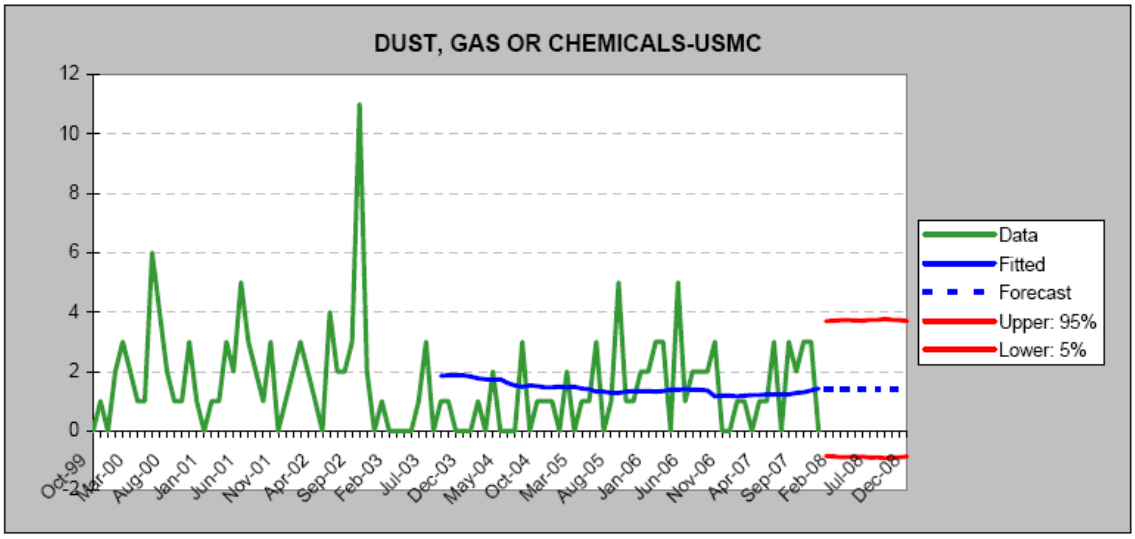
Series: DUST, GAS OR CHEMICALS-USMC **Range: C5:CW5**

Method: Single Moving Average
Parameters:
Periods: 47
Error: 1.3810

Series Statistics:
Mean: 2
Std. Dev.: 2
Minimum: 0
Maximum: 11
Ljung-Box: 30.3122

Forecast:

Date	Lower: 5%	Forecast	Upper: 95%
Jan-08	-1	1	4
Feb-08	-1	1	4
Mar-08	-1	1	4
Apr-08	-1	1	4
May-08	-1	1	4
Jun-08	-1	1	4
Jul-08	-1	1	4
Aug-08	-1	1	4
Sep-08	-1	1	4
Oct-08	-1	1	4
Nov-08	-1	1	4
Dec-08	-1	1	4



Series: MANUAL HANDLING AND EQUIPMENT-USMC **Range: C9:CW9**

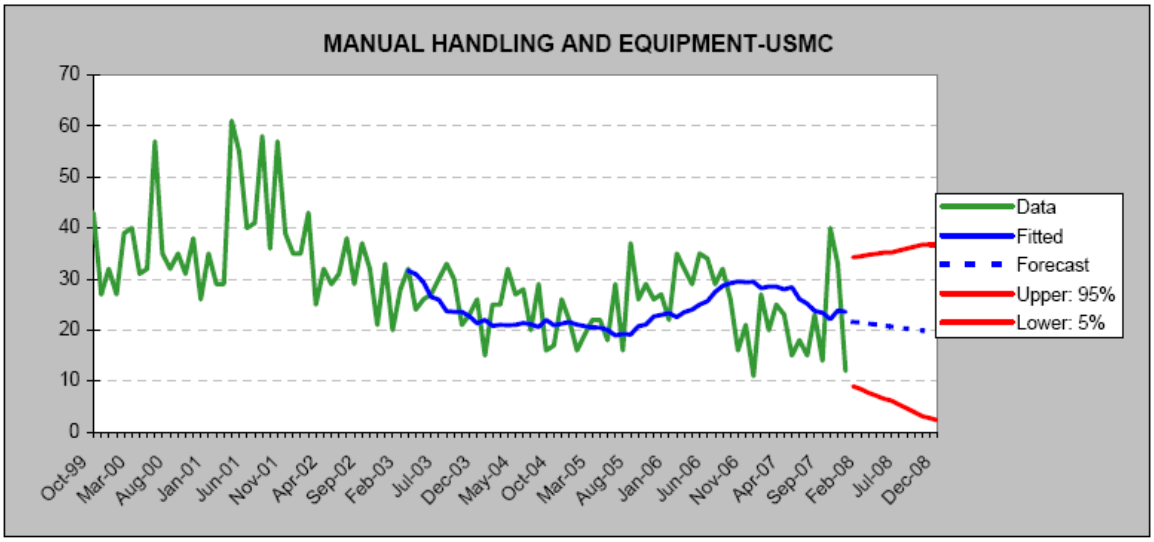
Method: Double Moving Average
Parameters:
Periods: 21
Error: 7.6302

-Low values in November and December
RMSE-7.6302 (relatively high for the extrapolated model)

Series Statistics:
Mean: 29
Std. Dev.: 10
Minimum: 11
Maximum: 61
Ljung-Box: 184.8218

Forecast:

Date	Lower: 5%	Forecast	Upper: 95%
Jan-08	9	22	34
Feb-08	8	21	34
Mar-08	8	21	35
Apr-08	7	21	35
May-08	7	21	35
Jun-08	6	21	35
Jul-08	5	20	36
Aug-08	5	20	36
Sep-08	4	20	36
Oct-08	3	20	37
Nov-08	3	20	37
Dec-08	2	20	37



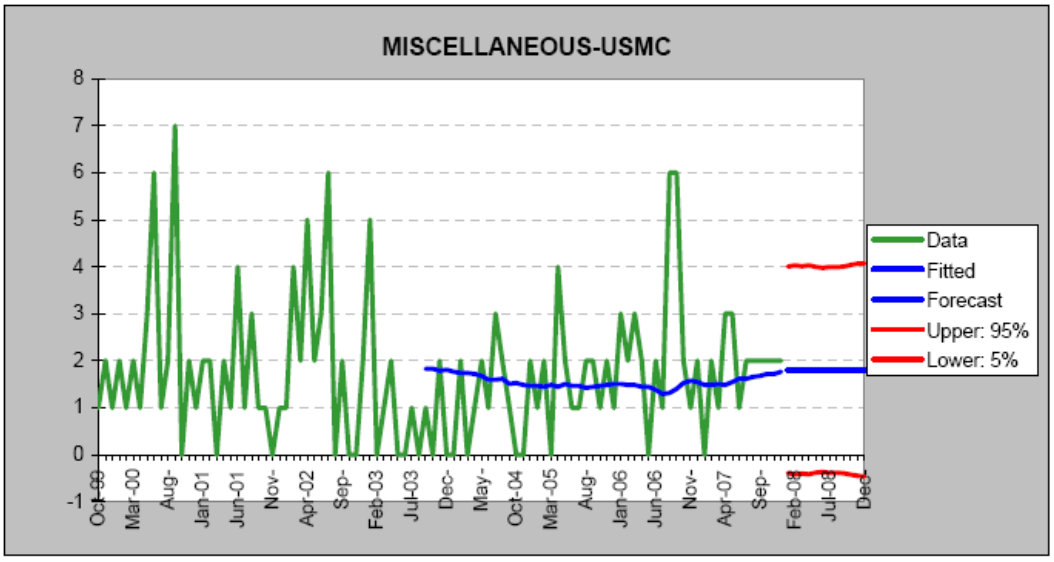
Series: MISCELLANEOUS-USMC **Range: C10:CW10**

Method: Single Moving Average
Parameters:
Periods: 47
Error: 1.3343

Series Statistics:
Mean: 2
Std. Dev.: 2
Minimum: 0
Maximum: 7
Ljung-Box: 28.2091

Forecast:

Date	Lower: 5%	Forecast	Upper: 95%
Jan-08	0	2	4
Feb-08	0	2	4
Mar-08	0	2	4
Apr-08	0	2	4
May-08	0	2	4
Jun-08	0	2	4
Jul-08	0	2	4
Aug-08	0	2	4
Sep-08	0	2	4
Oct-08	0	2	4
Nov-08	0	2	4
Dec-08	0	2	4



Series: Unspecified-USMC **Range: C11:CW11**

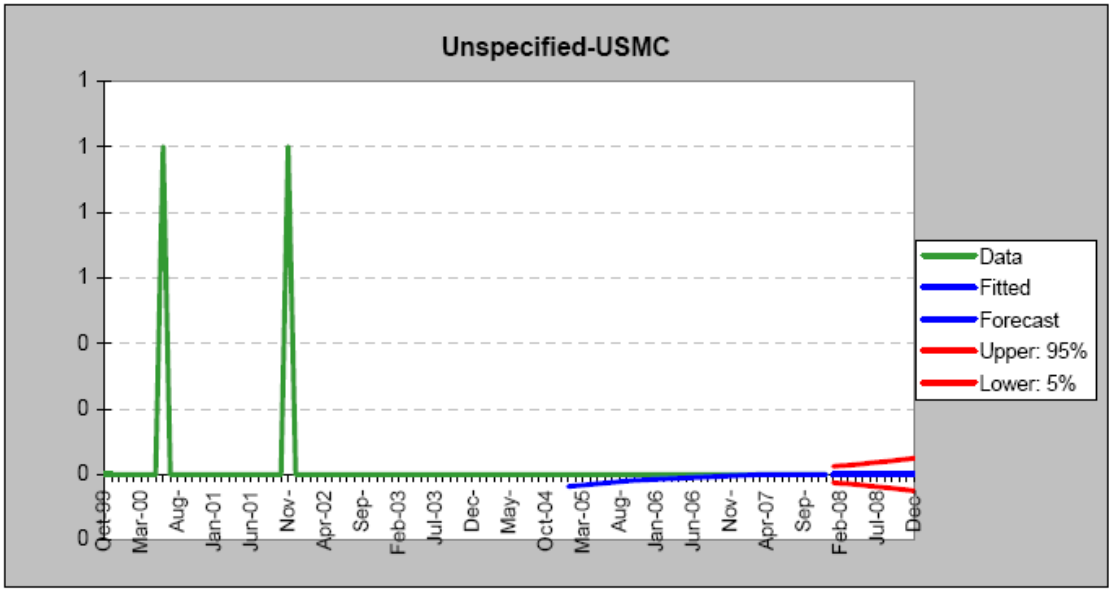
Method: Double Moving Average
Parameters:
Periods: 32
Error: 0.01605

-Could eliminate Unspecified and fold into Unclassified

Series Statistics:
Mean: 0
Std. Dev.: 0
Minimum: 0
Maximum: 1
Ljung-Box: 30.8669

Forecast:

Date	Lower: 5%	Forecast	Upper: 95%
Jan-08	0	0	0
Feb-08	0	0	0
Mar-08	0	0	0
Apr-08	0	0	0
May-08	0	0	0
Jun-08	0	0	0
Jul-08	0	0	0
Aug-08	0	0	0
Sep-08	0	0	0
Oct-08	0	0	0
Nov-08	0	0	0
Dec-08	0	0	0



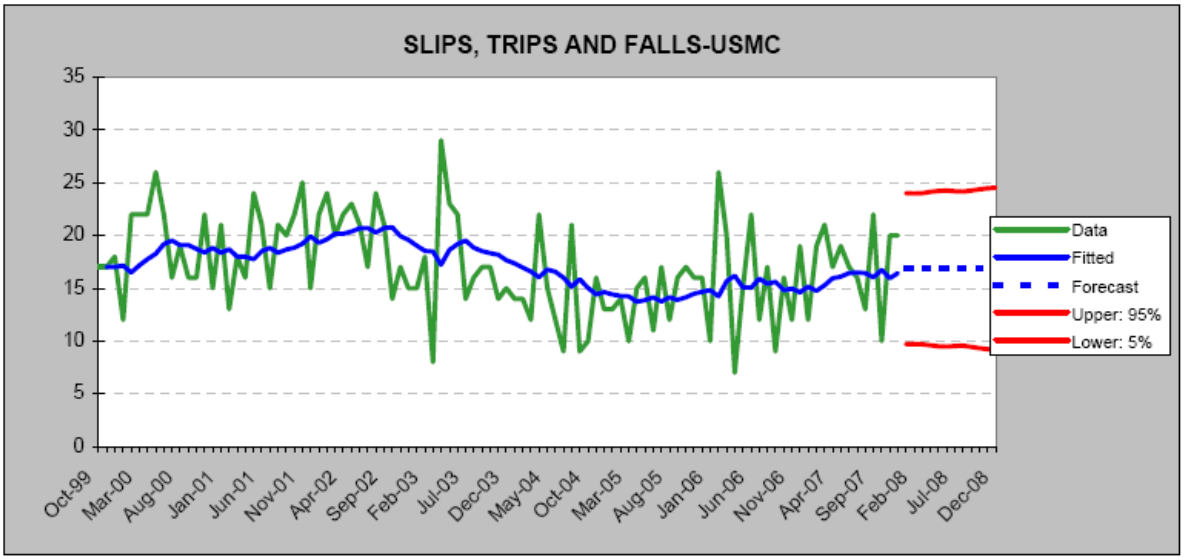
Series: SLIPS, TRIPS AND FALLS-USMC **Range: C12:CW12**

Method: Single Exponential Smoothing
Parameters:
Alpha: 0.120
Error: 4.3181

Series Statistics:
Mean: 17
Std. Dev.: 5
Minimum: 7
Maximum: 29
Ljung-Box: 66.5280

Forecast:

Date	Lower: 5%	Forecast	Upper: 95%
Jan-08	10	17	24
Feb-08	10	17	24
Mar-08	10	17	24
Apr-08	10	17	24
May-08	9	17	24
Jun-08	9	17	24
Jul-08	10	17	24
Aug-08	10	17	24
Sep-08	9	17	24
Oct-08	9	17	24
Nov-08	9	17	24
Dec-08	9	17	25



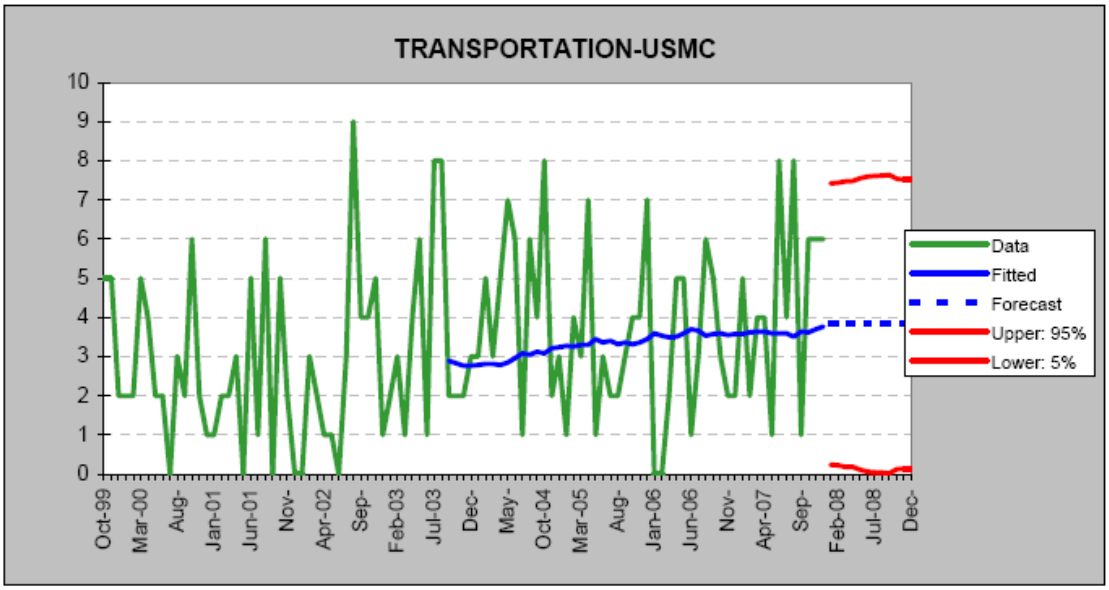
Series: TRANSPORTATION-USMC **Range: C13:CW13**

Method: Single Moving Average
Parameters:
Periods: 47
Error: 2.1843

Series Statistics:
Mean: 3
Std. Dev.: 2
Minimum: 0
Maximum: 9
Ljung-Box: 27.6516

Forecast:

Date	Lower: 5%	Forecast	Upper: 95%
Jan-08	0	4	7
Feb-08	0	4	7
Mar-08	0	4	7
Apr-08	0	4	7
May-08	0	4	8
Jun-08	0	4	8
Jul-08	0	4	8
Aug-08	0	4	8
Sep-08	0	4	8
Oct-08	0	4	8
Nov-08	0	4	8
Dec-08	0	4	8



Series: UNCLASSIFIED-USMC **Range: C14:CW14**

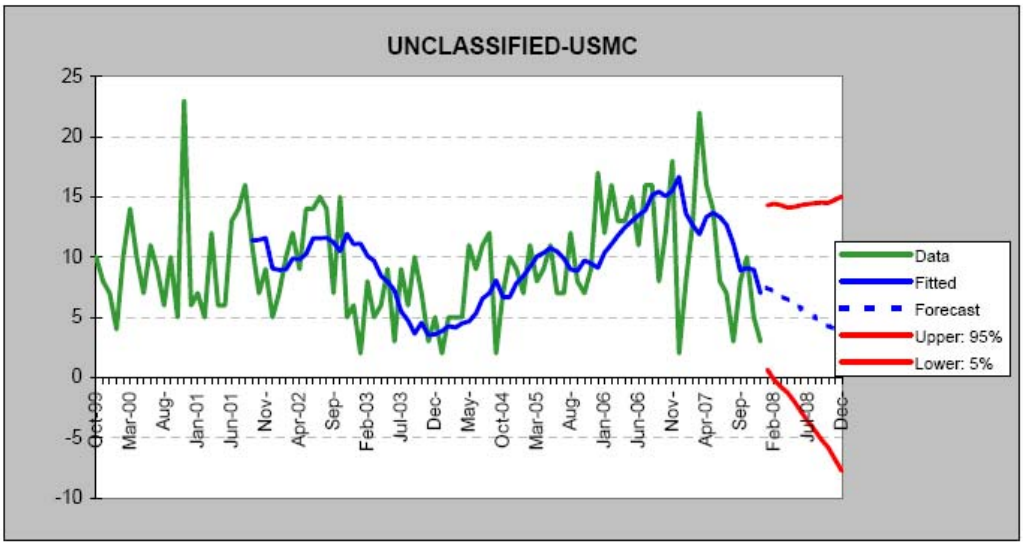
Method: Double Moving Average
Parameters:
Periods: 12
Error: 4.1232

- Erratic data due to lack of clarity on what defines "Unclassified"

Series Statistics:
Mean: 9
Std. Dev.: 4
Minimum: 2
Maximum: 23
Ljung-Box: 59.9521

Forecast:

Date	Lower: 5%	Forecast	Upper: 95%
Jan-08	1	7	14
Feb-08	0	7	14
Mar-08	-1	7	14
Apr-08	-1	6	14
May-08	-2	6	14
Jun-08	-3	6	14
Jul-08	-4	5	14
Aug-08	-4	5	14
Sep-08	-5	5	15
Oct-08	-6	4	14
Nov-08	-7	4	15
Dec-08	-8	4	15



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APPENDIX C. USMC "NATURE OF INJURY" TIME SERIES PREDICTIONS

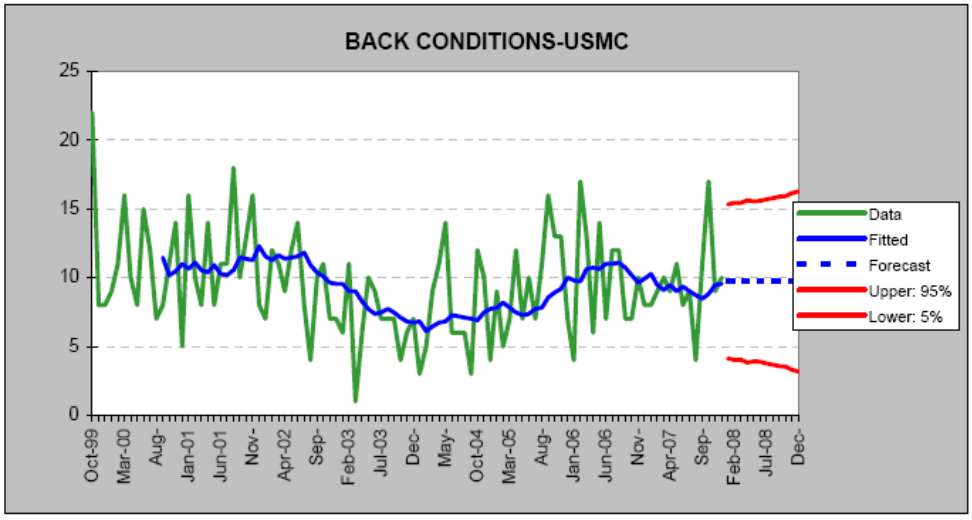
Series: BACK CONDITIONS-USMC **Range: C22:CW22**

Method: Single Moving Average
Parameters:
Periods: 11
Error: 3.4071

Series Statistics:
Mean: 9
Std. Dev.: 4
Minimum: 1
Maximum: 22
Ljung-Box: 36.9529

Forecast:

Date	Lower: 5%	Forecast	Upper: 95%
Jan-08	4	10	15
Feb-08	4	10	15
Mar-08	4	10	15
Apr-08	4	10	16
May-08	4	10	16
Jun-08	4	10	16
Jul-08	4	10	16
Aug-08	4	10	16
Sep-08	4	10	16
Oct-08	4	10	16
Nov-08	3	10	16
Dec-08	3	10	16



Series: EYE INJURIES-USMC **Range: C32:CW32**

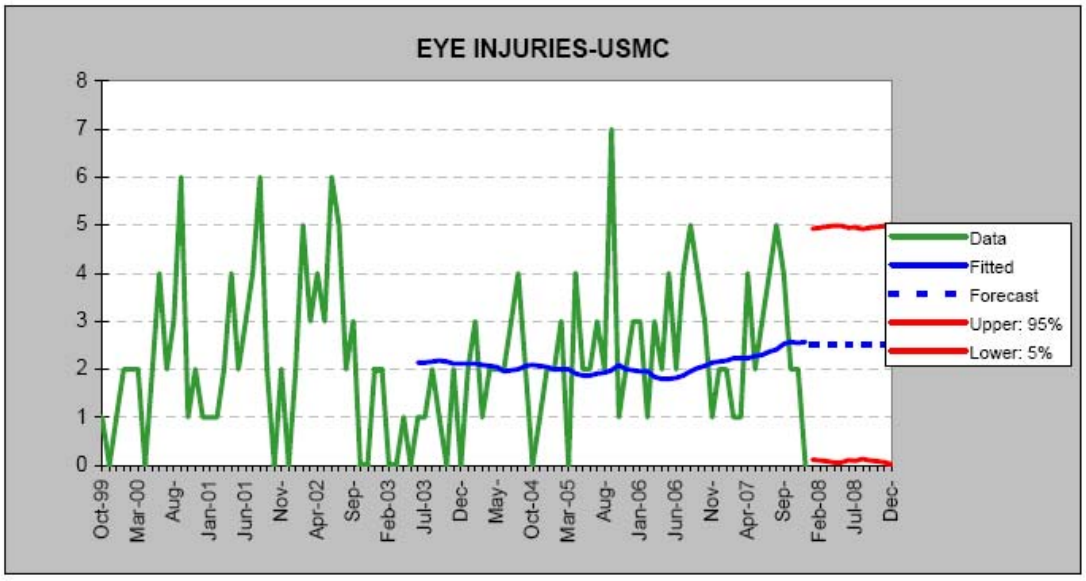
Method: Single Moving Average
Parameters:
Periods: 44
Error: 1.4619

-Higher probability of eye injuries in the summer months

Series Statistics:
Mean: 2
Std. Dev.: 2
Minimum: 0
Maximum: 7
Ljung-Box: 64.8824

Forecast:

Date	Lower: 5%	Forecast	Upper: 95%
Jan-08	0	3	5
Feb-08	0	3	5
Mar-08	0	3	5
Apr-08	0	3	5
May-08	0	3	5
Jun-08	0	3	5
Jul-08	0	3	5
Aug-08	0	3	5
Sep-08	0	3	5
Oct-08	0	3	5
Nov-08	0	3	5
Dec-08	0	3	5



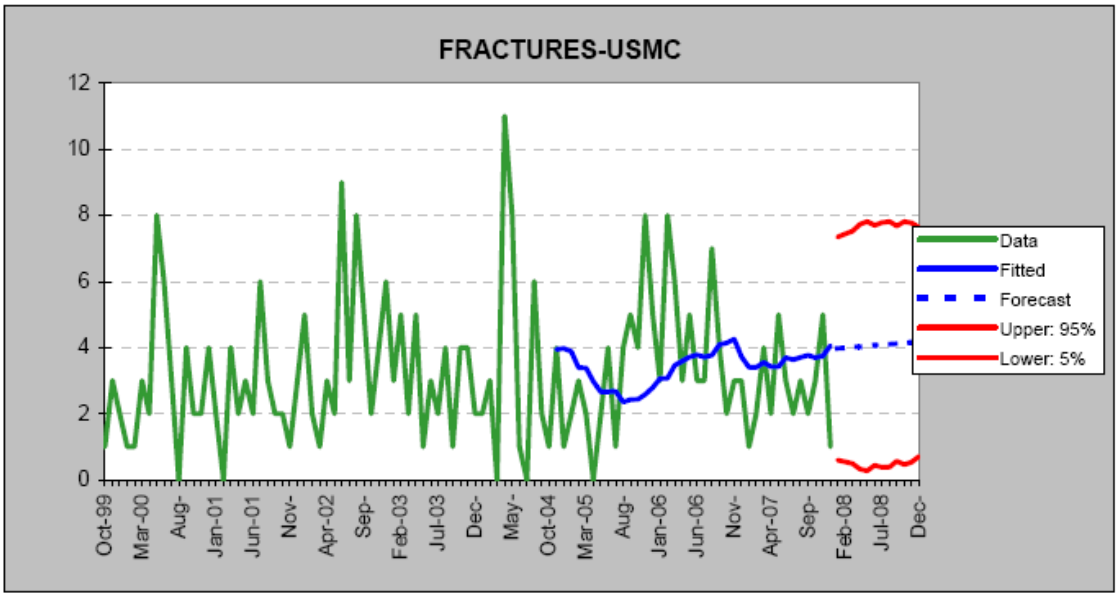
Series: FRACTURES-USMC **Range: C33:CW33**

Method: Double Moving Average
Parameters:
Periods: 31
Error: 2.0258

Series Statistics:
Mean: 3
Std. Dev.: 2
Minimum: 0
Maximum: 11
Ljung-Box: 36.4068

Forecast:

Date	Lower: 5%	Forecast	Upper: 95%
Jan-08	1	4	7
Feb-08	1	4	7
Mar-08	0	4	8
Apr-08	0	4	8
May-08	0	4	8
Jun-08	0	4	8
Jul-08	0	4	8
Aug-08	0	4	8
Sep-08	1	4	8
Oct-08	0	4	8
Nov-08	1	4	8
Dec-08	1	4	8



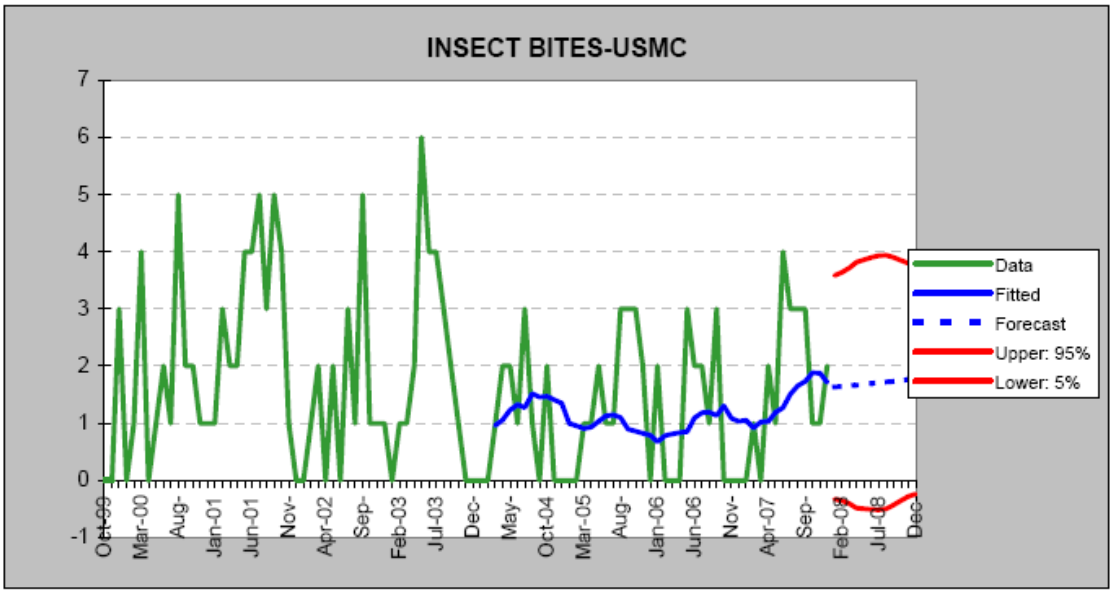
Series: INSECT BITES-USMC **Range: C39:CW39**

Method: Double Moving Average
Parameters:
Periods: 27
Error: 1.1773

Series Statistics:
Mean: 2
Std. Dev.: 1
Minimum: 0
Maximum: 6
Ljung-Box: 123.1242

Forecast:

Date	Lower: 5%	Forecast	Upper: 95%
Jan-08	0	2	4
Feb-08	0	2	4
Mar-08	0	2	4
Apr-08	0	2	4
May-08	0	2	4
Jun-08	-1	2	4
Jul-08	-1	2	4
Aug-08	0	2	4
Sep-08	0	2	4
Oct-08	0	2	4
Nov-08	0	2	4
Dec-08	0	2	4



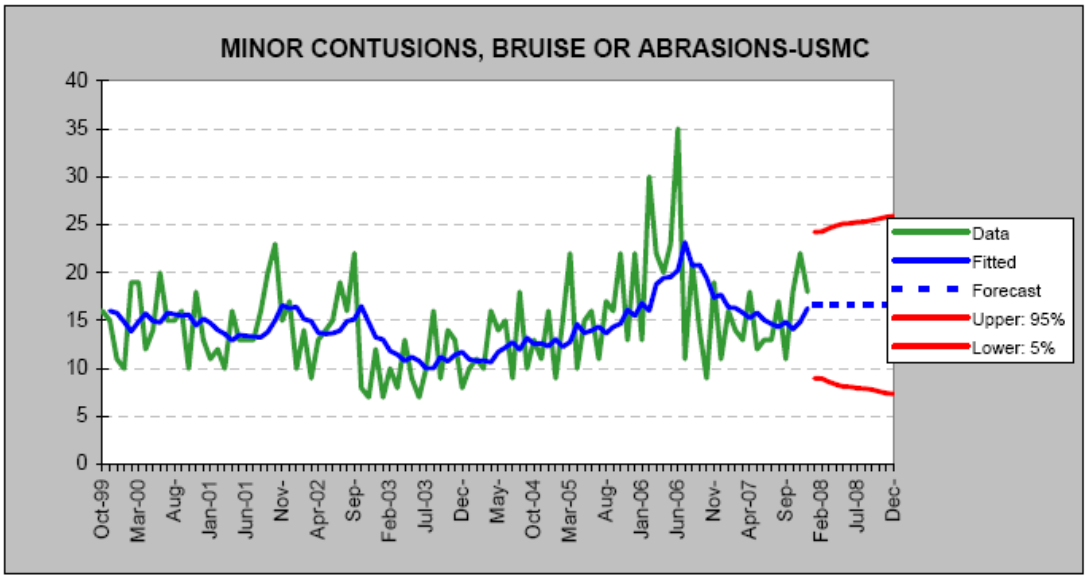
Series: MINOR CONTUSIONS, BRUISE OR ABRASIONS-USMC **Range: C41:CW41**

Method: Single Exponential Smoothing
Parameters:
Alpha: 0.198
Error: 4.6171

Series Statistics:
Mean: 15
Std. Dev.: 5
Minimum: 7
Maximum: 35
Ljung-Box: 52.6342

Forecast:

Date	Lower: 5%	Forecast	Upper: 95%
Jan-08	9	17	24
Feb-08	9	17	24
Mar-08	9	17	25
Apr-08	8	17	25
May-08	8	17	25
Jun-08	8	17	25
Jul-08	8	17	25
Aug-08	8	17	25
Sep-08	8	17	25
Oct-08	8	17	26
Nov-08	7	17	26
Dec-08	7	17	26



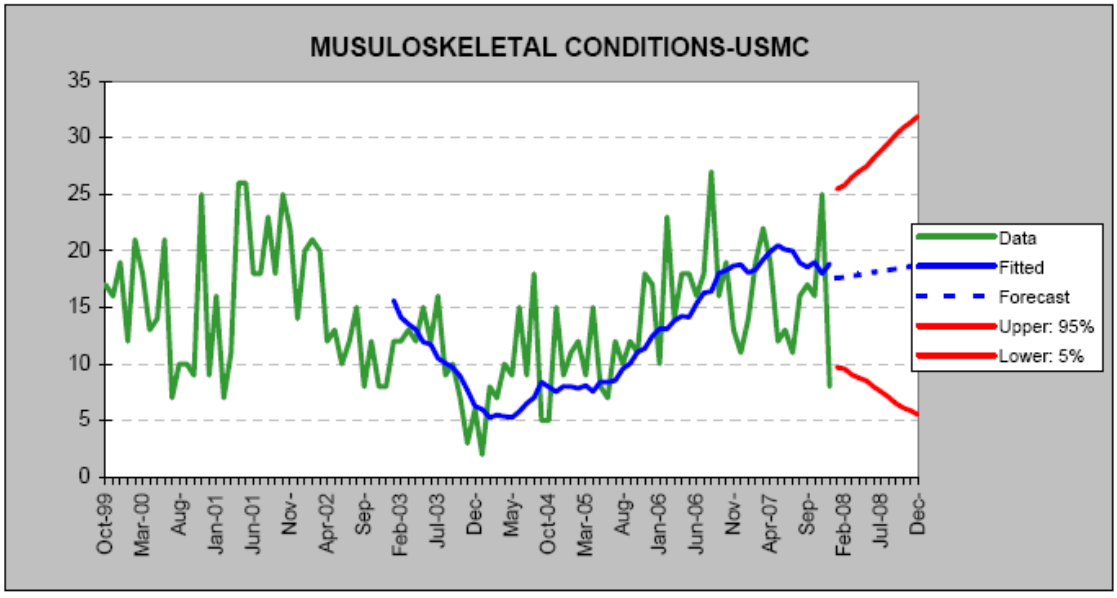
Series: MUSULOSKELETAL CONDITIONS-USMC **Range: C42:CW42**

Method: Double Moving Average
Parameters:
Periods: 20
Error: 4.7708

Series Statistics:
Mean: 14
Std. Dev.: 6
Minimum: 2
Maximum: 27
Ljung-Box: 137.2680

Forecast:

Date	Lower: 5%	Forecast	Upper: 95%
Jan-08	10	18	25
Feb-08	10	18	26
Mar-08	9	18	26
Apr-08	9	18	27
May-08	9	18	27
Jun-08	8	18	28
Jul-08	8	18	29
Aug-08	7	18	30
Sep-08	7	18	30
Oct-08	6	19	31
Nov-08	6	19	31
Dec-08	6	19	32



APPENDIX D. FRAUDULENT CLAIM TRAINING FOR SAFETY MANAGERS

The USMC TCR is sensitive to any fluctuation in cases and a reduction in injury cases aids in the lowering of the USMC's TCR. For example, if the Marine Corps were to reduce cases by 10% the mean monthly TCR decreases by 0.05. Figure 30 shows the effect.

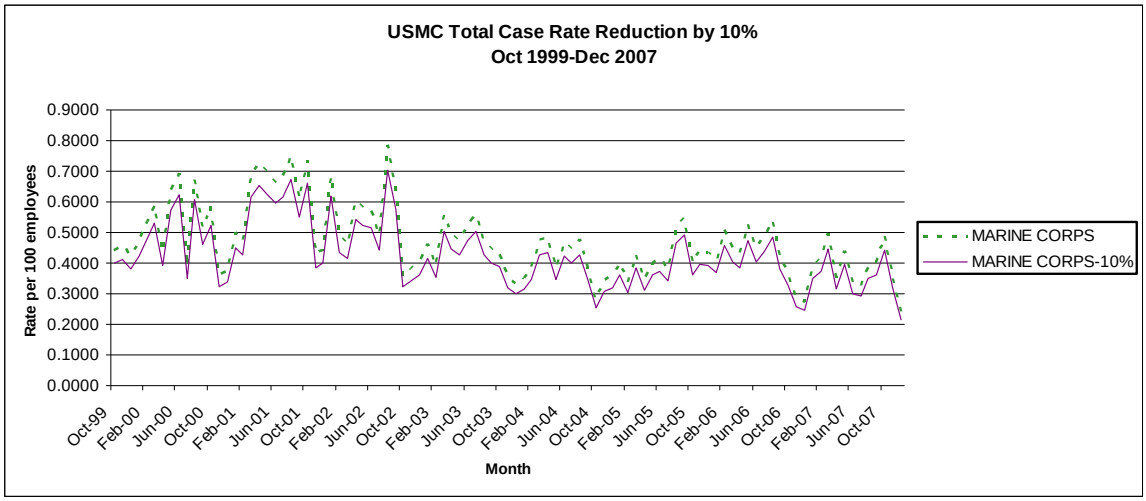


Figure 30. USMC Total Case Rate Simulated Reduction by 10%

One way to lower the number of injury cases is to identify and substantiate fraudulent claims. However, note that neither the supervisor nor the employing agency has the power to make a final determination on the claim. The decision rests with OWCP (Gilchirst-Saunders et al., 1999).

The following is a list of items taken from the Injury Compensation Program Administrator Handbook. These may serve as guidelines for identifying potentially fraudulent cases and for how supervisors and others should handle particular situations.

1.) The employee has told different people different stories surrounding the nature and circumstances of the injury. In this case the supervisor should request written, signed and dated statements form each of the parties involved.

2.) Several witnesses give a different account of the facts surrounding the injury. In this case, written, signed and dated statements should be obtained from each witness.

3.) On the day of the claimed injury, the employee reported to work with the appearance of a pre-existing condition or injury. The supervisor and other persons who can testify to this should submit signed and dated statements noting this observation.

4.) If the person waits a long period of time to report the injury (perhaps several weeks or months) and reports to work in the interim without appearing injured, and is able to carry out normal job functions, the supervisor should give a written statement to this effect saying that he or she (the supervisor) was <u>not</u> aware of an injury.

5.) The employee is not reporting for work, and someone reports that the employee is working at another job. In this case the Compensation Specialist would send a letter requesting information on the current employment of the employee. The CS may request a special release from the employee, permitting the agency to request a special release from the other employer. The employee may refuse to sign the release; he or she cannot be required to do so. The CS should also give serious consideration this type of case to the agency's Inspector General, or equivalent official with the employing agency.

6.) The supervisor or CS finds out that the employee was receiving the same medical treatment prior to the claimed injury, and there is no indication that disability was aggravated or accelerated by the claimed injury. In this case, the CS would request information form the attending physician regarding the previous condition.

7.) Medical reports indicate the condition that exists is a degenerative condition, and is not caused by a single incident. In this case, only Continuation of Pay would be controverted, as the employee may still be eligible for compensation.

8.) In cases where there are no witnesses, and the location of the alleged injury is in question, you may ask how the employee was able to get home with such a severe injury.

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